THE GLASS INDUSTRY

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GLASS AND THE FUTURE

By A. E. PAVLISH

Battelle Memorial Institute, Columbus, Ohio

A brief review of some of the things that have contributed to the industry's efficiency, increased production capacity and expanded markets.

The glass industry is one of the few major industries which produces a basic product utilized, in some form or other, by people in all walks of life.

The size of the glass industry compared with other industries is surprisingly large. Glass production on a tonnage basis is as large as gypsum, aluminum, magnesium, copper, lead, zinc, plywood, synthetic rubber and plastics production combined. Today, about 211 glass companies operate 313 glass factories. Of the nonmetallic industries, only the concrete, lumber and structural clay products tonnages exceed that of the glass industry.

Trends and changes in the industry by necessity are related intimately with 1) the development of new products and 2) the actual production of the glass. The importance of new products to the growth and prosperity of the industry is self-evident. The latter item, however, is controlled by many factors which contribute to the efficient production of saleable ware. The melting of the glass, for example, which is of prime importance, is influenced by refractories, fuels and raw materials.

Refractories

The efficiency of the melting operations has improved markedly in recent years and, in many cases, about twice the pull on tanks is being obtained compared with that of a few years ago; some tanks are in operation with pulls of about four times the 1940 rates.

The quality and productivity of modern glass-furnacing operations are affected directly by the refractories available for the operation. In the case of the large production continuous tank units, a definite trend toward the use of superior refractories has permitted an increase in the productive capacity without marked sacrifice in quality and, in most cases, with an increase in the quality of the glass produced. The use of super refractories in continuous tanks permits higher operating temperatures and, therefore, higher productivity. The use of fused cast refractories for certain parts of the tank furnace has made possible considerably improved operating efficiencies.

The various branches of the glass industry are interested in the development of superior refractories which will permit the production of a quality glass at reasonable costs per unit of production. Fused cast refractories have been developed which contain appreciable amounts of chromium and which do not appear to contaminate the glass significantly during melting. This opens up an interesting field for future refractory development. Improved silica brick is another example of an improved refractory. The improved silica brick has found wide acceptance in the steel industry and, even though the capital investment is greater, the unit cost per ton of steel produced is lower owing to its increased life and service.

Research and development work on refractory pots for glass melting, both in this country and in England, has led to some improvement in this product. The Molochite pot, developed in England; the cast pots, produced at the Bureau of Standards; and other development work should lead to a refractory pot which will permit the production of glass of higher quality. Fundamental research leading to a thorough understanding of the corrosion of refractories by glass is essential to the future development of improved materials for use in this operation. Once a basic understanding is obtained of the process of corrosion, as related to the composition of the refractory and the glass, development of superior glass refractories should follow rapidly. This basic knowledge best can be supplied by the cooperative effort of the refractory and glass industries.

Raw Materials

The primary raw materials required by the industry generally are available in large quantities but the industry is not the major consumer of many items. The basic raw material requirements often are integral factors in the choice of the actual location of the glass plant. The quality of glass produced, in many cases, reflects quality of the raw materials, and the American glass industry is striving constantly for a general improvement of quality in order to maintain the position of the American industry in a competitive world. A simple raw material such as sand, although widely distributed, contains appreciable amounts of impurities which are undesirable in the production of high-quality ware. For example, sand often contains* many minerals other than quartz, a few of which, such as rutile and the iron minerals, are detrimental to the production of a good-quality product. Increased beneficiation by physical means of some of the natural raw materials may be necessary to obtain a product of the desired quality. Individual plants, whether they be the machine operated or hand plants, have their own specifications for raw materials, but cooperative endeavor by the plants might provide beneficial improvements in raw materials. Increased consideration has been given and presumably will be given in the future to the possible utilization of cheap sources of raw materials which can be beneficiated for use in glass production. For example, iron blast-furnace slag, which is now used in the production of amber glass, can be beneficiated at the producing plant or in the glass batch to permit its use in the production of glass other than amber. The consideration of more economical materials from the standpoint of actual cost per ton of glass is of prime importance to the glass industry to permit the industry to maintain its competitive position.

Melting

Considerable interest has been aroused in the possibility of utilizing electric melting for the production of glass. Electric melting**, as an auxiliary fuel, found widespread use in foreign countries during the late war as one means of increasing the production of glass as well as of overcoming difficulties with fuels which were used prior to the outbreak of the war. In France, the Compagnie de Saint Gobain operated about 70 plants utilizing electric melting. In all of these cases, the conventional glass melting equipment was adapted to electric melting, and the production rate was reported to have increased appreciably; in some cases, increases in production as much as 100 per cent were reported. In this country, electric melting operations were comparatively uncommon until recently, and generally were located near sources of cheap electric power. Recent trends, however, indicate that electric melting may be used for the specific objective of producing desirable glass at high rates. Development work along these lines has progressed rapidly, and results indicate that glass can be produced, in some cases, about five times as fast as with conventional fuel melting. This high rate of production may offset the higher cost of electric power in some areas in order to gain other advantages from a production standpoint.

The evidenced wide interest in the general subject of melting and its relation to the production and quality of glass should result in the development of improved melting techniques. The increased rates of production which have been obtained within the past few years have been the result of the combined effects of improved refractories and "know-how" which have permitted the operation of tanks at higher temperatures. A trend toward development of melting units along more functional lines for specific jobs has been indicated in recent articles†, and this is an approach which will bear watching. Somewhat radical departures from normal practices might be a step in the right direction. As an example, a foreign plant reputedly melted glass electrically in a large tank, and this glass then was fed into a number of separate chambers in which Globar elements were used for fining and homogenizing. Various colors reputedly could be produced by making the necessary additions in the separate fining chambers††. A scheme of this type might permit operation at extremely high rates with a minimum number of melting tanks, but with a large number of fining tanks. A trend away from pot melting by the quality hand producers is taking place. Day tanks are becoming quite common in many of the plants.

Automatic Control

The advances made in the fields of instrumentation and automatic control are being employed to improve the efficiency and economy of glass-melting and glass-working operations. The more refined types of automatic control, such as the proportional control, are replacing the simple on-off systems and are making control operations easier and more precise. The use of automatic feeder temperature control has resulted in increased machine speeds and more constant gob weight. Automatic tank pressure and combustion air intake control provide more uniform combustion. Economical operation is aided by control of the furnace fuel input and the furnace operation can be evened out, with a resultant fuel savings and increased refractory life, by the use of automatic time reversal controls. More widespread use of such control systems and introduction of furnace temperature and glass level control systems in the future will aid further the production of glass.

Metallurgy

The glass industry has availed itself of new metallurgical developments. More widespread use is being made of special alloy metals which will withstand higher temperatures than cast iron, which has been widely used in the industry in the past. The use of these more heat-resistant alloys has permitted the production of specific items which could not be produced otherwise. Alloy mold materials covered with a chromium plate particularly have been effective in this respect. The chromium plate, when properly applied, enhances materially the surface characteristics of the pressed object in addition to providing the desired and necessary life during the operation. In the course of the development of this process, the method of treating the pieces to be

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* Bulletin No. 1, Rutgers University Bureau of Mineral Research, 1948.
** THE GLASS INDUSTRY, February, 1948, p. 71.
† THE GLASS INDUSTRY, November and December, 1948, p. 615 and p. 694.
†† Private communication.

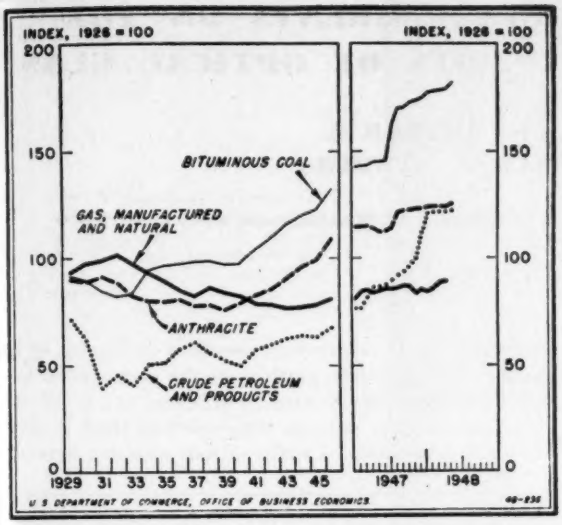


Fig. 1. Wholesale prices of mineral fuels.

plated and the techniques in plating had a marked bearing on the quality of the plated product.

Fuel

Fuel is one of the most important basic commodities utilized by the glass industry. Changes in the fuel employed have altered markedly the trends in the industry and have contributed to its enormous growth. Since the early days of glass making when wood was used as a fuel, the location of the industry and its general movement followed the changes in the fuels used in the production of glass. Fuel still plays a dominant role and is one of the critical materials which must be considered in any long-range development of the industry. This general subject has been discussed* widely in the last few years owing to the limited potential lifetime reserves of some of the fuels. Coal, oil, natural gas and electric power are available to the industry at the present time. Natural gas is a most desirable fuel for use in the production of glass, but it also has a rather limited life based on the known reserves. Moreover, the large and varied demands for gas by other industries and for domestic purposes are factors which are disadvantageous and which must be considered when evaluating gas as a fuel. The shift from coal to petroleum or natural gas as primary sources of energy, a trend which has been in progress for decades, has been accelerated in recent years. The desirability of liquid or gaseous fuels is obvious in the production of glass by present methods of processing.

Figure 1 shows that the general price of fuels has advanced in line with the upward movement of the general price level, but that the structure of fuel prices has undergone substantial change and presumably such changes will continue in the future**. The desirability of oil and gas as sources of energy, as well as rapid developments in equipment to burn these fuels, has contributed to their substantial growth in recent years.

Figure 2 shows that the most striking change during the past three decades is the marked decline in the relative importance of coal as a source of energy and the increase in petroleum, gas and water power. The trends in the use of fuels, in the glass industry and in industry in general, are not compatible with the proven reserves of the various fuels. In some respects, it would appear that the glass industry is in about the same position with respect to fuel at the present time as it was at the time when it utilized wood as a fuel. The supply of wood continually decreased and ceased to be an economical fuel from the standpoint of the future of the industry. The coal reserves of this country are, for all practical purposes, unlimited, whereas the other fuels which are being utilized have definite limitations so far as the future of industry goes. For this reason, coal is likely to be more economical in long-range development of the glass industry. The present methods of producing glass do not permit the direct utilization of coal as a source of energy. Methods of utilizing this fuel indirectly, such as in the development of electric energy, or conversion to a gaseous fuel appear to be trends to be considered in the future of the industry. The efficient utilization of this basic fuel may be tied up closely with the development of superior gasifying equipment or in the development of melting units which can utilize electrical energy produced from coal or water power. The location of plants will be determined to a large degree by the consideration of these future trends. Atomic energy as a fuel has been discussed as a potential source of energy, but it is doubtful if this will be generally available for years to come.

Geographic Shifts

Changes in the location of glass plants are occurring

(*Continued on page* 116)

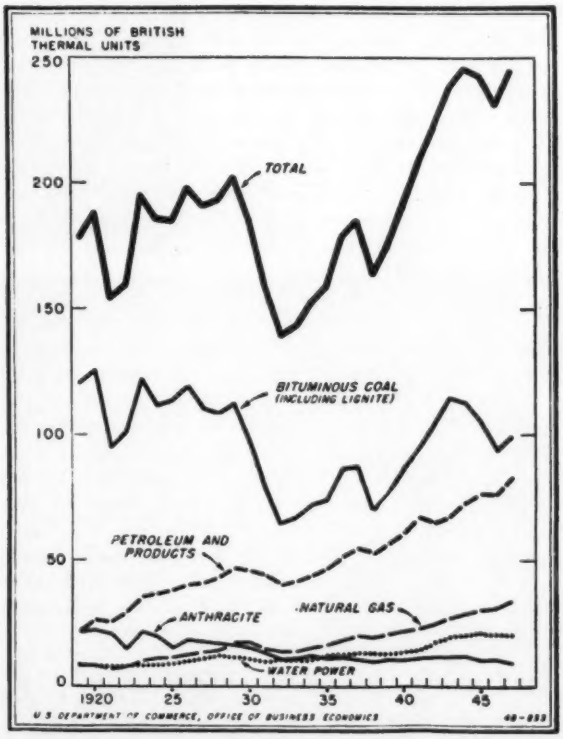


Fig. 2. Per capita consumption of energy from mineral fuels and water power.

* Glass Industry, February, 1948, p. 81 and Combustion, October, 1948.
** Dept. of Commerce Report, Survey of Current Business, July, 1948.

THE EFFECT OF CONVECTION CURRENTS ON THE DISTRIBUTION OF STRIAE IN POTS OF OPTICAL GLASS

By CONRAD A. FAICK, ARTHUR E. WILLIAMS AND GERALD F. RYNDERS

Dept. of Commerce, National Bureau of Standards, Washington, D. C.

PART I

CONTENTS

I. Introduction.
II. Location and shape of striae bands.
III. Cooling procedure.
IV. Study of convection currents. 1) Temperature distribution in a pot of glass. 2) Tracing convection currents.
V. Discussion.
VI. Conclusion.

Abstract

The striae distribution in pots of optical glass was studied and the role of convection currents in causing this distribution was established. Tracing the convection currents and studying the effect of various cooling techniques on such currents was achieved through the introduction of copper oxide into the melts on their removal from the furnace.

I. Introduction.

In all optical glass manufacture a large proportion of the glass in a pot is rejected for defects of one kind or another. Striae, or streaks of different composition within the glass mass, constitute one of the major defects. They are present in all pots of optical glass. However, the amount of glass rejected because of striae is dependent entirely on its distribution in the glass. Fenner[1], Roberts[2] and Wright[3] state that convection currents, set in motion after a pot of glass is removed from the furnace, are largely responsible for the large amount of glass rejected for striae.

Other factors, such as pot solution[4], volatilization and effectiveness of stirring, probably determine the amount of striae present, but their distribution is due primarily to convection currents. If the stirring is adequate to keep ahead of striae formation, and if the pot of glass at the time of removal from the furnace is free from striae except possibly for a thin layer in contact with the pot and on the surface of the glass, the problem of striae control becomes one of reduction or control of convection currents.

This paper deals with a study of the striae bands found in optical glass, the role of convection currents in striae distribution and variations of cooling techniques used to reduce or control convection currents.

II. Location and shape of striae bands.

It has been the practice at the National Bureau of Standards[5] to tank inspect all optical glass prior to molding it into lens blanks. This inspection of a large number of melts revealed the tendency for striae to be concentrated in certain portions of the melt and to follow a characteristic pattern. For closer study of the striae distribution, samples were selected from definite portions of the melt. Usually fifteen samples were in-

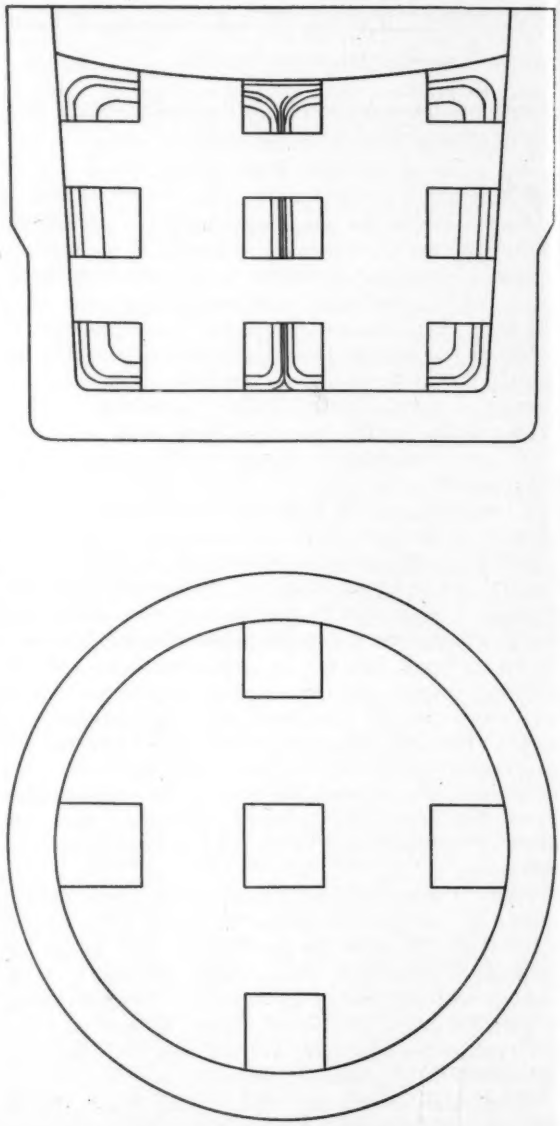


Fig. 1. Diagrams showing the location of the 15 samples chosen for inspection, and the approximate location of the main striae bands.

Fig. 2. Samples from the middle level showing striae bands along the left side of the pot and the end of the loop caused by convection currents.

Fig. 3. Heavy striae band curving around lower left corner of pot.

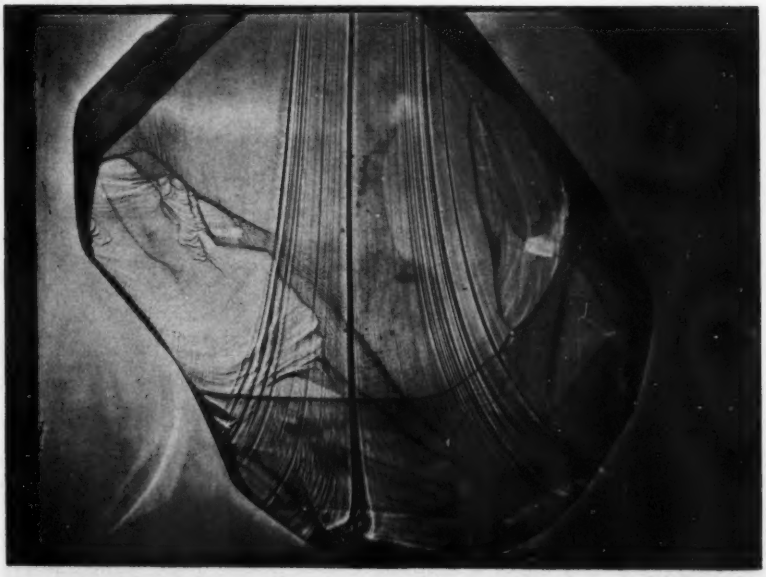


Fig. 4. Sample from bottom center of a melt showing the origin of the heavy vertical striae band.

Fig. 5. Sample from top center of a melt showing the horizontal surface striae band (A), and the curving of the heavy vertical band (C) toward the right side of the pot.

Fig. 6. Sample from top right side of a melt showing a band of striae (C) curving downward into the melt, and a heavy band (B), very close to the pot wall.

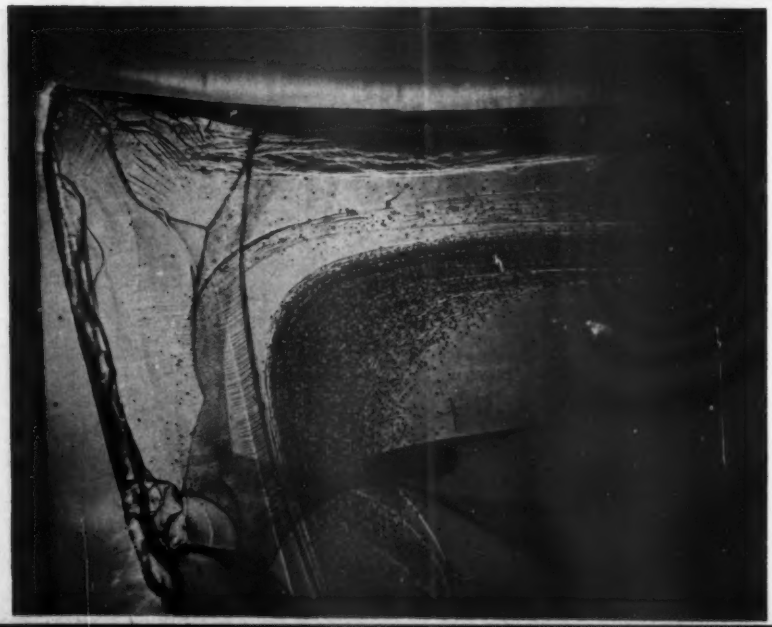


Fig. 7. Sample from top left side of a melt showing a cloud of seeds associated with a heavy band of striae.

spected for each melt representing the center and four quadrants at three different levels, i. e., top, middle and bottom.

From observation of the striae in the samples, sketches were often made that showed the pattern of the striae and permitted an estimate of the amount present. The sketches shown in Figure 1 illustrate the position of the samples chosen and a typical striae pattern. The characteristic of the striae as revealed by these studies was a heavy vertical band, originating at the bottom of

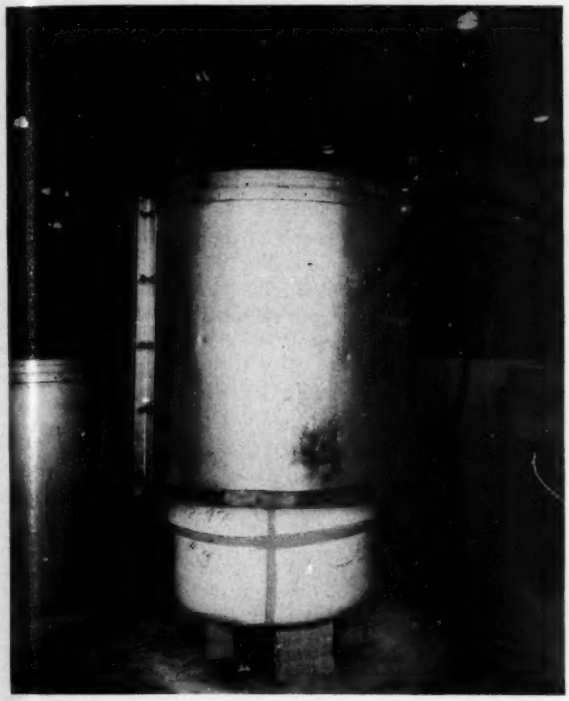


Fig. 8. Cooling cover in suspended position over a pot of glass.

the pot, going up the center, then spreading across the top and going down the sides. Sometimes this heavy band spread out at the top like branches on a tree; but frequently it practically all deviated to only one side, probably because unsymmetrical cooling caused a migration in one direction. The distance of the striae from the top, sides and bottom was measured on the selected samples and found to vary between ½ inch and 4 inches, the average distance being 1½ inches.

The characteristic striae pattern usually found in a pot of optical glass is illustrated by a few selected samples which were photographed[6] through the windows of the immersion tank of the inspection apparatus. These are shown in Figures 2 to 7, inclusive.

Figure 2 shows the bands down the side of the pot and a loop of striae, probably representing the end of the center band, brought up into the glass by convection currents. Figure 3 shows a heavy band of striae curving around the lower corner of the pot; Figure 4 shows the heavy central vertical band which is believed to be the origin of most of the striae in the glass. Figure 5 shows the heavy vertical band curving toward the side near the surface. Also, there is shown a band of striae parallel to the surface that does not appear to be related to the

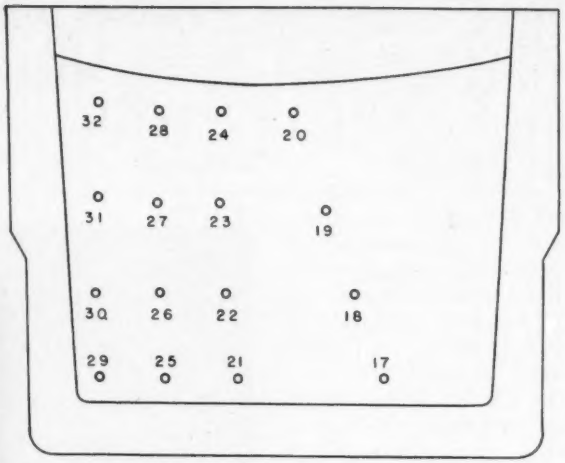


Fig. 9. Position of thermocouples employed for the study of the temperature distribution in a pot of glass. The numbers used here refer to the numbers on the recorder to which the thermocouples were connected.

former. Figure 6, the top edge, shows the end of the heavy vertical band curving downward after having moved across the top of the pot. It also shows a heavy band very close to the pot wall, which may be the source of the horizontal layer (A) shown in Figure 5.

Figure 7 shows the striae in a sample from the top left side of a melt, and a cloud of "seeds" associated with it.*

III. Cooling procedure.

Since the magnitude of the convection currents depends largely on the method of cooling a pot of glass

* Occasionally a melt was produced in which a cloud of seeds formed during the last few minutes of stirring; at times it migrated from the center of the pot toward the edge, and on subsequent inspection of the glass was found to occupy the same region as the main striae band.

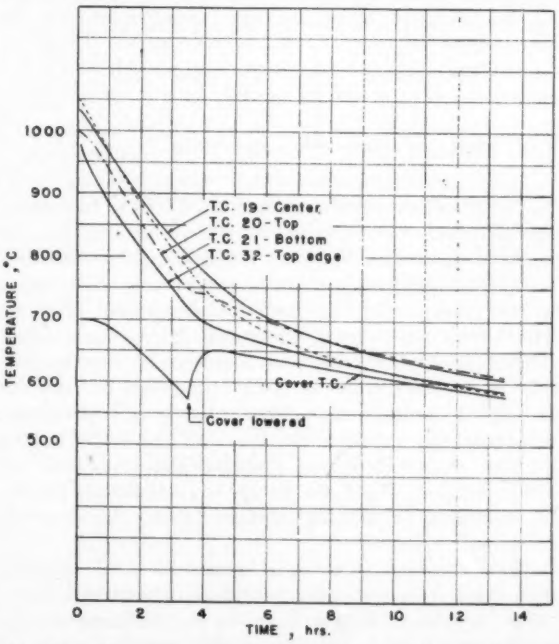


Fig. 10. Time-temperature relations in various portions of the glass as shown by thermocouples 19, 20, 21 and 32.

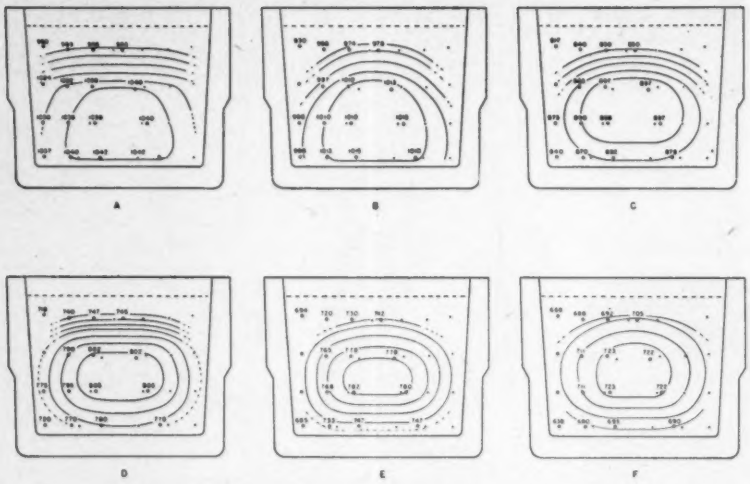


Fig. 11. Probable isotherms in a pot of glass during cooling. a) 10 minutes after removal from the furnace. b) ½ hour after removal from the furnace. c) 2 hours after removal from the furnace. d) 3½ hours after removal from the furnace (the cooling cover was lowered to the floor at this time). e) ½ hour after lowering cooling cover. f) 2 hours after lowering cooling cover.

after removal from the furnace[2], a brief description of the cooling technique will be given before describing the experiments made to trace the convection currents.

After a pot of glass is removed from the furnace, an insulated can is provided to cool the melt to room temperature. This can consists of a sheet metal cylinder lined with 4½ inches of insulating brick, and a lid with 9 inches of insulation. A base metal thermocouple is in the lid. A triangular suspension is attached to the outer shell and the whole assembly placed over the pot by means of an overhead hoist.

The can is suspended over the pot, at a height determined largely by experience, and allowed to hang in this position for several hours, then lowered to cover the pot. The time of lowering the can is determined by the temperature indicated by the thermocouple in the lid. This temperature is purely an arbitrary value, but is usually somewhere near the critical temperature of the glass as shown by its expansion curve. Variations in the height at which the can is suspended and the temperature at which it is lowered are the means of controlling the type of fracture produced. Figure 8 shows a cooling can in its position over a pot of glass.

IV. Study of convection currents.

1. Temperature distribution in a pot of glass. Regular production borosilicate melts, 517/645, containing approximately 1,000 pounds of glass, were used for the study of convection currents. The first melt of the series was used to determine the time-temperature distribution in the glass during the cooling down period after removal from the furnace. Following the regular production schedule[5], the melt was transferred from the furnace at a temperature of 1025°C to piers beneath the suspended cooling can. After placing 16 base-metal thermocouples in the melt, the can was lower to the position shown in Figure 8 and a blower placed beneath the pot. When the temperature indicated by the thermocouple in the lid reached 575°C, the can was completely lowered.

These thermocouples were connected to a 16-point strip-chart recorder and a continuous time-temperature record obtained. Figure 9 shows the locations of the thermocouples after the pot of glass was broken open for inspection. Couples 17, 18, 19 and 20 were intended to go down the center of the pot, but the support broke at the time of immersion allowing them to deviate to one side. It was assumed that the temperature distribution would be symmetrical about the center line of the pot. A comparison of the temperature shown by the deviated couples with the adjacent column of couples tends to substantiate this assumption.

Assuming symmetrical temperature distribution, a series of drawings were made showing the probable isotherms at various times during cooling of the melt. From the time-temperature curves of Figure 10 and the probable isothermal sketches of Figure 11, the temperature changes taking place during the first few hours of cooling are readily apparent.

At the time of removal from the furnace the central and lower portions of the melt were considerably hotter than the top, but horizontal gradients were relatively slight. One-half hour later the top edges had become considerably colder than even the top center. As cooling continued, the top edges and sides cooled more rapidly than the bulk of the glass, but nearly two hours elapsed before the bottom showed any appreciable drop in temperature below the center portion.

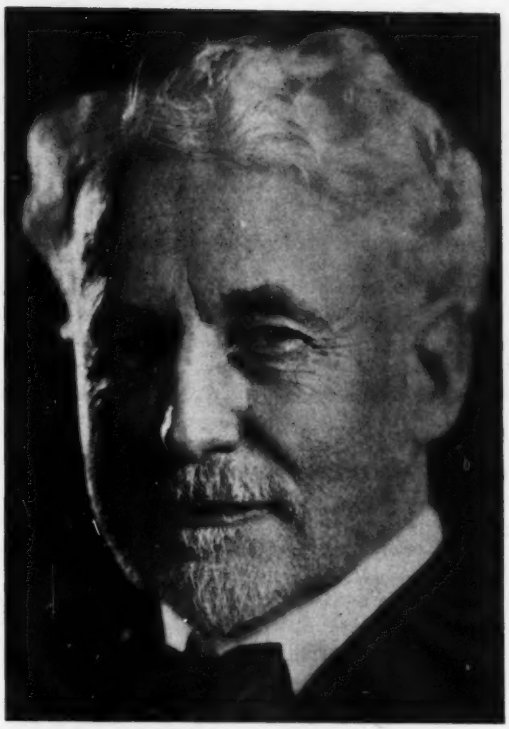
When the cooling can was lowered to the floor, there was a definite change in the rate of cooling of the various portions of the melt (see Figure 10). About 3½ hours later, the top center had become the hottest portion. The rapid cooling of the top edges during the early stages was regarded as the cause of the observed convection currents due to changes in density.

INTERNATIONAL COMMISSION ON GLASS

Until the adoption of the new constitution now under revision, the following members comprise the International Commission on Glass: Denmark, A. H. M. Andreasen; Spain, J. A. De Artigas; Great Britain, B. P. Dudding and W. E. S. Turner, President; Czechoslovakia, M. Fanderlik; Belgium, P. Gilard; United States, J. C. Hostetter; France, Bernard Long; Germany, H. Maurach; India, Atma Ram; Sweden, B. Simmingskold; and Holland, J. A. Stevels.

ROSS COFFIN PURDY

1875–1949



The death of Ross Coffin Purdy on January 6, 1949, brought to an end a lifetime devoted to the advancement of ceramics. As chemist, engineer, instructor and as an officer of the American Ceramic Society, Ross C. Purdy's contributions to the industry have been outstanding.

Born on March 3, 1875 in Jasper, New York, Dr. Purdy's education began at public school and following the natural course of events, he entered Syracuse University in 1896. Two years later, he transferred to Ohio State University when he learned of the first four-year course in ceramics to be offered there. The death of his father very soon after this transfer necessitated his changing to a two-year industrial course from which he graduated in 1898, continuing his studies on a competitive scholarship for another year.

He joined the Mosaic Tile Company as chemist and assistant superintendent, later becoming associated with Roseville Pottery and the Buckeye Pottery Company. With the latter firm, he developed various colored glazes and assisted in sales. In 1902, General Edward Orton, Jr., Director of the Department of Ceramic Engineering at Ohio State University, invited Ross Purdy to become instructor, which position he accepted and retained until the fall of 1905, when he was made assistant professor of ceramics at the University of Illinois. In this capacity, he organized and equipped the Department of Ceramics and also served as ceramist with the Illinois Geological Survey, publishing a number of bulletins on fritted and crystalline glazes and on the pryochemical and physical behavior of clays.

Returning to Ohio State University in 1907 as an assistant professor, Dr. Purdy was appointed full professor in 1911. He resigned this professorship in 1912 to become Director of Laboratory Research for the Norton Company, manufacturers of abrasives. Upon leaving Norton Company in 1919, he engaged in private consultation as ceramic engineer.

During this period, Dr. Purdy had become interested in the American Ceramic Society and in 1907, became its Vice President. During 1908-1909, he was elected President and from 1917 to 1922, he was Membership Chairman.

It was in 1922 that Dr. Purdy was made General Secretary of the Society. It was his idea that industrialists, as well as educators and research men, should be cared for by the Society. It was also Dr. Purdy who, as far back as 1918, was responsible for the creation of Industrial Divisions with separate programs at Annual Meetings. Local sections and student branches were organized under his guiding hand in a number of the universities. In this way, the Society was strengthened by avoiding the breaking up of groups to form individual societies. It was also through the influence of Dr. Purdy that Federal bureaus developed an interest in ceramics and established government divisions. His influence was felt not only in this country, but abroad where he had insured contacts with many societies and industrial groups. His personally conducted tour of Europe in 1928 with a group of seventy Society members was memorable for having established a feeling of good will between ceramists in this country and in Europe.

During his career, Dr. Purdy was awarded nearly every honor which can be bestowed upon a ceramist. He was a Fellow and Honorary Life Member of The American Ceramic Society; one of the Founders Group of the Institute of Ceramic Engineers; an Honorary Member of the Canadian Ceramic Society, the Indian Ceramic Society and the Czechoslovak Ceramic Society; Honorary Life Member of the Ohio Ceramic Industries Association and of the United States Potters Association; an Honorary Fellow of the Society of Glass Technology, and an Honorary Member of Keramos. He received an honorary degree of Doctor of Science from Alfred University in 1936.

In 1946, following twenty-four years of devoted service, Dr. Purdy, then General Secretary, retired from the American Ceramic Society. In 1948 he was presented with the medal and scroll of the first Albert Victor Bleininger Award for distinguished achievement in the field of ceramics.

Dr. Purdy is survived by his wife, Myra, known as "Mother Purdy" to Society members, and three daughters, Mrs. Reliance Leiter, Canton, Ohio, Mrs. Constance Cone, Columbus, Ohio, and Mrs. Lois Turner, Forrest Lake, Illinois.

GLASS IN THE INDIAN COUNTRY

By MARCEL LEFEBVRE

"I'd rather be a wild uncivilized Indian than a glass-worker."

An Old Indian Chief is reputed to have made that remark as he walked out of a Coffeyville, Kansas, glass factory in 1902. Little significance had ever been given any glass article by the Indian, and this visit had probably been more confusing than enlightening.

Indian travelers had returned from Kansas in awed veneration of what they had seen there. They related to their Old Chief that a new kind of white men had built a huge house with a chimney reaching to the sky. And it had a cooking oven with more fire than all the Indian camp fires put together, and big enough to roast hundreds of cattle at a time. They knew it sounded impossible, but it was there and they could prove it. His curiosity aroused, the Old Chief called a few of his young braves together and started off for Coffeyville, just across the Indian Territory line. As they entered the town, the tall chimney could be seen in the distance, rising straight against the blue skies. The group of curious Indians were thus guided to their destination.

All the windows and doors of the huge house were wide open, and as the group approached, they could hear that tremendous roar inside the building. Men, naked to the waist, were leaning out the windows and standing in the doorways, sweat streaming down their faces and bodies, their blue pants and shoes soaking wet with perspiration. Hesitantly, the Old Chief led the way up the crude wooden steps onto a small porch surrounded with a long board bench where a few more perspiring men, seated and resting, greeted the visitors with a cordial, "Hello."

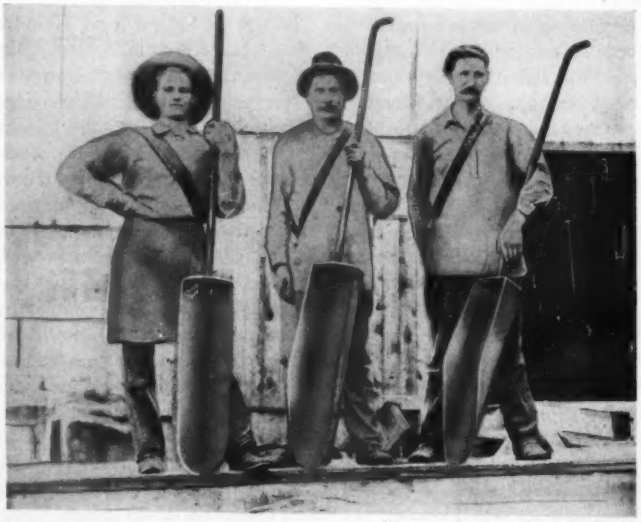
One of the half naked and perspiring men led the fascinated group of Indians to a safe spot inside and asked them to be careful, not to move around without first making sure that they were not in some worker's way running from one position to another carrying the heavy balls of molten glass on the end of those long iron pipes as they could not easily change their course after launching themselves towards the target, that black iron bowl setting in a tub of water, where another man took it and blew a large ball of the molten mass.

The roar of gas shooting into the furnace was deafening to the Red men when they had enered the building, and to say that they were continuously on the qui vivre, is to put it mildly. Every time a blower capped off a roller and threw the cap in the cullet box, an Indian jumped; or when a snapper cracked one open, Indian heads turned in all directions, uneasy brown eyes flashing wonderment, ready to leap anywhere for safety.

They watched, with effusive interest, the gatherers dip the long pipes in the hot furnace through the small round holes, turn the pipe in the molten glass and bring it out with more glass on it to cool on a tub of running water. After repeating the process four times, the ball of hot glass on the end of the pipe just barely squeezed through the round hole. After setting the pipe on the tub for a few minutes in the running water and always turning the pipe to keep the ball of hot glass from flowing down, the gatherer would dash with it to the other end of the room and drop it in that large iron bowl where the other fellow blew so hard that his cheeks seemed ready to burst. Then another half naked man would take the huge ball and run with it to the furnace, set it up in a large round hole and turn like mad; always, everybody turned the pipes. It made the Indians dizzy. Then they would swing the ball down in a large hole in the floor and the ball became a long cylinder, but always of the same circumference. Then they would blow some more in the cylinder and a hole appeared in the end. The hole increased in size until it was entirely opened, and the visiting Indian Chief's party stood aghast. This was not witchcraft—they were watching civilized white men earn a living the hard way, in hellish heat. And that was the thought that had prompted the Old Chief's remark, quoted in the opening lines of this story.

A year or so later, the Great Western Glass Company, capitalized for $75,000, with Col. W. F. Lytle, President D. A. Lytle, Secretary, J. J. Campbell, Vice President, and William Jaraskouw, General Manager and Superintendent, was organized in Bartlesville, Indian Territory, on December 26, 1903, to manufacture all kinds of novelties besides lamp chimneys and lantern globes. Operations began on April 8, 1904 with 35 employees.

No records are available but it is reasonable to believe that this pioneer plant was visited by many Indians during the ensuing years. For here, in



Courtesy, Mrs. E. Majot.

These three men unloaded all the raw materials, mixed the batch and filled the pots for eight shops. 1901.

their own country, was one of those hellsinabuilding full of sweating white slaves, blowing molten glass into transparent articles of all shapes.

The Great Western Glass Company did not locate in Oklahoma (or rather, Indian Territory) merely to amuse the Indians. They chose the Bartlesville site immediately following the opening of the first oil and gas field south of the Kansas state line. It was only natural for glass to follow gas.

In searching state libraries, historical records and old newspaper files for names, dates, locations and hundreds of other data necessary for an historic text on glass, the most successful trails to follow are two of four letters—F-U-E-L and S-A-N-D.

When the first glass factory was established in America, by Dutch and Polish Colonists in 1608, fuel was the primary consideration. The Colonists erected their small pot furnace in the midst of the best fuel available in those days, a forest of pine trees along the Atlantic Coast.

The chronicles of early glass making in the Atlantic states describe the bitter rivalries among the manufacturers for timberland control. He who owned the pine forests, controlled the fate of his competitors. One of the most interesting "timber wars" on record took place in Millville, New Jersey.

According to the records contained in that City's library, Bergen and Pierson erected the first window glass factory in that town during the year of 1818. It was sold to Scattergood, Haverstick and Booth in 1835 to be converted into a bottle plant. In the year of 1845, John Mickle Whitall, Israil Franklin Whitall and others, bought the property and operated as Whitall Bros. & Company. Edward Tatum became manager in 1848 and the firm name was changed to Whitall, Tatum & Company.

During Mr. Tatum's management, the company purchased a window glass factory located in South Millville, on Maurice River, known as the Schetterville plant. Behind the purchase of this plant, however, lies the story of scheming, intrigue and boldness, of determined men against their contemporaries. The sheriff had closed the Schetterville plant in 1844. It had later been operated by Coffin, Mulford & Company. The name, Mulford, belonged to one Lewis Mulford, who founded the Millville National Bank, and became it's first president in 1857.

Wood and resin were the only available fuels in quantities, and to own the timberlands meant a natural source of great wealth and power. Mr. Lewis Mulford readily recognized the potentiality in such control and quietly acquired complete control of the wood market for miles and miles around Millville.

He then decided to withdraw from the glass business and offered to sell the Schetterville plant to Whitall, Tatum & Company. The latter refused to consider the proposal. They were not interested in additional plants, and Mr. Mulford's terms were far from attractive anyhow.

But, of course, Mr. Mulford did not offer to compromise, nor did he appear to experience any discomfiture by the refusal. He merely served notice on Whitall, Tatum & Co. that unless they agreed to his terms, their fuel supply would be discontinued. The Company soon realized that if they intended to continue the manufacture of bottles in their original plant, they would have

Courtesy, Window Glass Cutter's League of America.

Tools used in making window glass by hand.

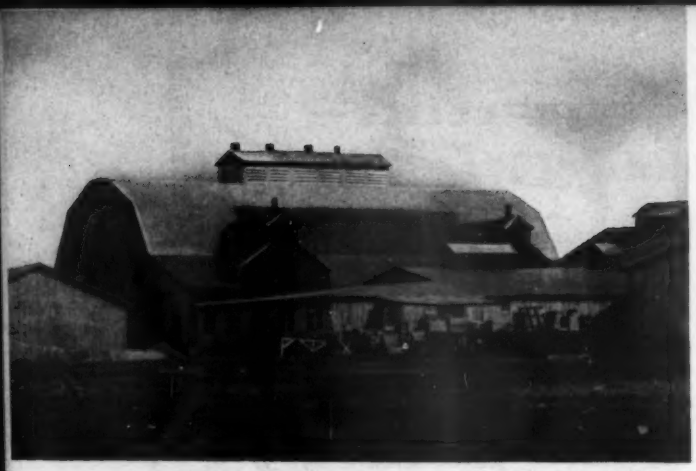
to accept Mr. Mulford's proposal. They did. And the Schetterville plant soon became an important adjunct to growing Whitall, Tatum & Company, who probably saved their business by accepting an unwanted burden forced upon them by a rival. Fuel was all important for survival, at any cost. The company prospered and became one of the modern-day large producers. The same property is today owned and operated by Armstrong Cork Company.

To fully appreciate the steady westward march of the glass industry, it's growth and spread from the Atlantic states through the midwest and southward, a study of geologists' reports on natural gas and oil discoveries across the nation is necessary and very interesting. Glass has followed gas like the tail follows a dog.

While there were a few small wood or coal burning furnaces in New York and Pennsylvania, it was only after commercial development of the natural gas fields that the glass industry mushroomed in adjacent towns and throughout those states. On and on, it marched westward and southward. For years it centered near the geographical center of the country.

The great pipe lines that carry the daily supply of gas for glassmaking bring to mind an early anecdote which, reputedly, took place a little more than one hundred years ago. Daniel Foster, a farmer near Findlay, Ohio, was digging a well for fresh water. One day he barely escaped death by asphyxiation by a hurried climb up the latter. He reached the surface to fresh air just in time. He could not have gone much farther. He had struck a gas pocket which filled the excavated well and flowed on up into the hot summer breeze.

That escaping gas troubled Foster for many days. He would walk to the well, around the barn, measure distances to and from the kitchen. He'd scratch his head in deep thought. There must be some way of capturing



Courtesy, Mrs. E. Majot.

An early 8-pot factory, La Rusch Glass Company, Matthews, Indiana, 1901. Note the five-stall cutting room in the foreground.

that gas and using it. His pioneer resourcefulness would not be denied, but it took several days and nights of deep thought. He finally struck upon an idea that set him to work as he had never worked before.

When Daniel's father had migrated from New England in search of a new country years before, he had in his wagon a large sugar kettle. Black and worn by many years of use over large log fires, its round bottom turned up with four tiny legs pointing straight to the sun. That same kettle was now lying near the woodpile where Daniel's wife was gathering fire wood for the kitchen stove. Daniel thought of all the cords of wood he had chopped for that cook stove since his boyhood days, and of all the wood he would have to cut in the future. If he could in some way bring that escaping gas to the kitchen stove, his wood chopping days would be over.

Then, like a flash, it struck him and he went to work with unusual vim. He had never been lazy, but his wife could not understand this sudden accelerated tempo. When she saw him cutting a hole in the bottom of the upturned sugar kettle, she thought surely that the stinking gas he had inhaled in the well a few days before had affected his mind and that he was really going crazy.

When he came in for dinner that day, he kept looking at the cook stove, then out the kitchen window. His wife studied him, wondering what he would do next. "What's the matter, Dan'l, feelin' bad?" she cautiously asked. "Nope, just athinkin' ", he replied. Not another word was uttered during the meal.

Here was a man deeply in thought evolving a method by which one of nature's wasting products could be made to help cook his meals. An idea that was destined to give birth to one of the leading industries of the world.

Early the following morning, Foster and a neighbor moved the heavy kettle over the hole in the ground and tamped clay around the edge so no gas would escape. He then drove a round stick, through which he had bored a hole from end to end, into the hole in the upturned kettle. From the barn, he and his helper brought forth several six-foot logs with a one inch hole bored through the length of each. They connected these logs together, caulking the joints with clay and binding with canvas strips. A line of hollowed logs stretched from the kettle to the kitchen, with one end attached to the hollow stick in the kettle. The gas flowed evenly out the other end.

Satisfied with the progress of the work, Foster eagerly stepped in the house carrying the barrel of an old gun. One end was plugged with clay and small holes were bored about half way along the barrel. After cleaning out the stove and making a few minor adjustments, the gun barrel was set in the stove's fire pot, the open end sticking out of the stove about one foot. A hole was cut through the kitchen floor and the log pipe extended to meet the metal barrel. These were connected by fitting the barrel inside the log and packing with clay. Then a binding of canvas was wound around the joint. The job was completed. Gas eased through the punctured gun barrel.

Mrs. Foster stood near the door as Daniel finished. She was ready to run for safety, or help, if anything went wrong with this crazy contraption. Daniel took the flint and steel from the buckskin bag hanging behind the stove. He wasn't too sure that it would work either, and it was with two very nervous hands that he struck flint against steel a few inches above the gun barrel. The first spark flashed and the gas burst into flame with a sudden blast. After the accumulated gas had burned out, a steady glow came from along the old gun barrel inside the stove. In triumph, Daniel called his wife to "come cook dinner on a fire that won't go out."

That was the first natural gas piped into an American home. Had Daniel Foster heard or read of the Chinese who centuries before had piped natural gas through bamboo tubes?

In 1865, several years after Foster's successful gas piping to his kitchen stove, a commercial pipe line conducted gas from West Bloomfield, N. Y. to Rochester, N. Y., a distance of 20 miles, through wooden pipes too. Today, there are more than 90,000 miles of steel pipe lines carrying over six hundred billion cubic feet of natural gas in the United States, or about $555,000,000 worth.

The history of glass manufacturing in Oklahoma is closely related to the successive changes which took place in early gas fields throughout the eastern United States which directly affected the glass plants in those states.

Indiana had developed, in the Muncie, Marion, Kokomo and Anderson area, gas fields of seemingly unlimited productivity towards the close of the century. Glass factories of all kinds, figuratively, blanketed that entire section of the state. But with the turn of the century, a rapid decline of supply from those fields induced a few manufacturers to move their plants to Kansas where extensive gas fields were being opened.

During the short period of three years, from 1902 to 1905, nineteen glass factories were established in Kansas and one in Bartlesville, just across the line in Indian Territory.

While an abundance of natural gas was available for all of these plants, sand, the most essential raw material in glass making, had to be supplied from the St. Peter sandstone, near Crystal City in eastern Missouri. That was a long haul for sand, and the railroads were not always able to make deliveries in time to keep the batch flowing through the doghouse rapidly enough to keep up with the gatherers and blowers on the other end of the tank.

A cheap, steady supply of sand was the dream of all Kansas glassmakers. One day a bed of what appeared to be good silica sand, was uncovered near Independence. There was approximately 40 acres of it. Here at last was a dream come true, and it looked like there would be enough for all the factories for years to come.

The Santa Fe Railroad Company was asked to run a spur to the plot, but refused to do so. The manufacturers, however, did not despair. The Midland Glass Company, nearest to the plot, hired a heavy wagon drawn by several teams of horses to haul a trial load to their plant. A batch was mixed containing some of the new sand and melted in pot #7. In due time the melt was ready and worked out into single strength window glass. As the rollers were blown and laid out on the horse, it became quite obvious that the much heralded find would never be used in making clear glass. The rollers were of a much darker hue than usual, but still the management did not give up. The blowing was flattened and cut into 2×2 inch lights and sent to many jobbers as samples. So far as is remembered by the cutter* who cut those samples, no order was ever received for green window glass. Crystal City continued to be the only source of supply for Kansas and Oklahoma factories.

The high cost of that sand—the freight was about four times the price per ton at the quarry—and a partial exhaustion of some of the gas pools forced a steady decline of glass manufacturing in Kansas. With 19 plants in 1905, the number had fallen to 5 in 1919, then to 1 in 1927 and none were listed in 1939.

In Oklahoma, by 1913, Bartlesville had 1 plant; Okmulgee, 2; Tulsa, 2; Avant, 1; six factories amidst abundant gas supplies but far from sand. The infant industry faced the same fate that had overtaken their neighbors in Kansas. Like a true and faithful guardian, geology came to the rescue.

The suffering glass industry was probably saved to grow and expand when, on January 1, 1913, a report by Frank Buttram on Glass Sands of Oklahoma was made public by the Oklahoma Geological Survey.

Mention was made above that, "To follow glass history, one must become acquainted with geologists." At first thought the average glass man might ask, "How does a geologist fit into the art of glassmaking?" The answer to that question can be made in a few simple words. Geologists have probably contributed more towards successful world competition for glass manufacturing in Oklahoma than has any other science. While the industry had expanded from one plant in 1903 to six in 1913, note that it increased to a high of nineteen plants immediately following the year of Buttram's report.

True, some of the increase was due to easy capital available in a new land of inestimable wealth and opportunity. Towns and cities offered free sites and financial aid to industries that would help increase their populations and payrolls. Some of these were short lived, but others managed to struggle through the growing pains of modernization and, finally, complete mechanizing. One of the worst depressions to ever hit the industry was survived too, but only because the geological survey had made possible a source of supply for the most essential raw material, sand, within economical hauling distances. That, more than anything else, gave the Oklahoma manufacturers a more equal stand in a highly competitive market.

For years, Oklahoma pioneers, from The Great Western Glass Company which had cast its lot under the Cherokee Nation flag to those who followed before and after statehood, experienced many interesting changes necessary during the transition of the Territory under Indian laws to the more familiar laws and conditions after statehood. The latter opened a vast undeveloped country for the white man's economic system. Many a sleepless night had been spent by managers and owners trying to figure out ways of meeting the weekly payroll after paying the gas bill.

Jersey had seen its glass manufacturers pitted against one another over control of timberlands, man against man. Oklahoma was watching its glass industry waging a battle too, a battle of man against economics. And man was losing the battle. Plants were deserted and hundreds of empty houses were torn down or left to go to ruins. No one wanted them. "Who wants to pay taxes on empty houses?", asked the owners. By 1939 only eight factories had weathered the storms through sheer pioneer resourcefulness and perseverance.

Buttram's geological survey and report had established sand deposits which, upon examination, showed a general high quality and suitability for making glass.

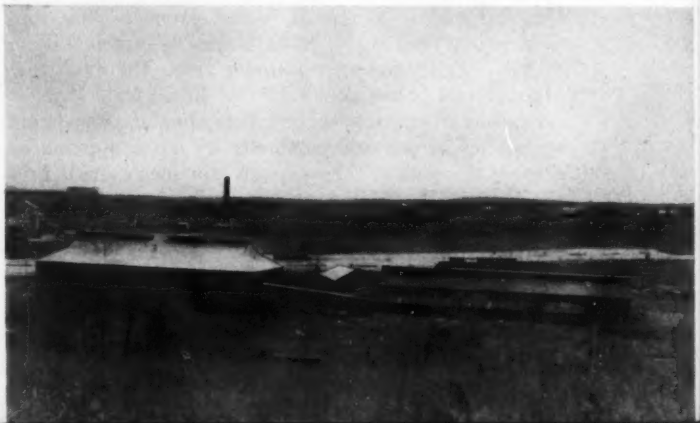
The deposits were: the Burgen Sandstone of Ordovican age, in the northeastern part of the state near Tahlequah; several beds in the Simpson formation (Ordovician) in the Arbuckle Mountains and the Trinity Sandstone of Cretaceous age, which crops out in a broad band between the Arbuckles and Red River from near Ardmore to the Arkansas state line. The Roff, Mill Creek, Sulphur triangle area covers approximately 400 square miles. The Mill Creek quarry has a face 62 feet high. With the discovery and opening of these sand deposits, Oklahoma glassmakers breathed easier. Had this been made possible in 1913?

Millions of tons of sand had been carried down the great rivers and deposited at the bottom of huge lakes and seas millions of years ago and later covered over by more countless centuries of rotting vegetation and other top soil forming elements until the sand was discovered and uncovered by modern geologists for a modern industry.

Many plants have come and gone since the day the Old Indian Chief journeyed to Coffeyville to see the amazing sight of men blowing transparent objects from

(*Continued on page* 117)

The Sunflower Glass factory at Sapulpa, Oklahoma, as it appeared about 1913. *Courtesy, Fred Grant.*



* Fred Grant, Inspector for Pittsburgh Plate Glass Co., Henryetta, Okla.

APPLICATIONS OF FUSED CAST ALUMINA REFRACTORIES IN THE GLASS INDUSTRY

By R. W. BROWN

The Carborundum Company, Refractories Division, Perth Amboy, N. J.

Several articles dealing with the properties of a group of electrically fused cast high alumina refractories, known as "Monofrax," have been published during the past few years. Therefore, this paper is intended to indicate the use and possibilities of these refractory products.

As to the background of fused cast alumina refractories, it seemed evident that high alumina fusions should receive full consideration at the outset of the development work. The original work was by no means limited to high alumina, as hundreds of different compositions were produced and tested carefully. However, it developed early in these investigations that the most promising materials all fell in the high alumina category.

The concept of high alumina refractories for glass tank work is a sound one since the interface between high alumina refractories and the glass being melted tends to be quite refractory and viscous. The composition of this interface, which is a thin film of glass between the lining and the bath, is determined by the composition of the tank block and of the particular glass being melted. With these high alumina compositions, the interface flow rate is only 2 or 3% of the flow rate of the glass being melted. This increased viscosity is a major factor in prolonging the life of the tank blocks.

In the superstructure, high alumina blocks, with a negligible glassy matrix, resist attack by an alkali laden atmosphere, obviating the formation of a mixture of corundum and glass which occurs when alumina-silica refractories are exposed to volatilized alkalis.

Although new mixes are being developed and tested, three product types are now available commercially, and a brief description of these three types follows:

Type H: Type H is composed of over 99% beta alumina crystals and contains less than .5% interstitial glass. It is a one phase body with large crystals, and has a relatively open structure. It provides definite advantages in the superstructure, but is not recommended generally for direct contact with molten glass. The large crystals are very inert to the attack of the glass, but due to the extraordinarily low amount of glassy matrix, the crystals may be washed out mechanically by the movement of the glass.

Type MH: Type MH, having the same approximate chemical analysis as type H, is also extremely pure, containing less than 0.3% of impurities of which 0.12 to 0.18% is Fe_2O_3 and the remainder TiO_2. The interstitial glass content is less than 1.8%. It differs from H in its crystalline structure in that the beta alumina crystals are broken up in size and continuity by alpha alumina or corundum crystals. The crystals are much smaller in size than in H. MH has a greater density than H, and its tighter crystalline structure makes it well adapted for contact with glass.

Paper presented before the Tenth Conference on Glass Problems, Ohio State University, Columbus, Ohio.

Type K: Type K is composed of approximately 85% to 87% alumina and approximately 13% chrome spinel. In this block, consumers obtain the advantages of a strong interlocking structure of chromite, but with the other virtues of a high alumina material. The alumina and chromite are largely in solid solution, and no interstitial glass has been found microscopically in K. The block is quite dense and erosion resistant.

These three compositions possess rather unique properties which may decidedly influence tank design, tank operation and life. These properties will be discussed in conjunction with such points as multiple course construction, balanced tank life, superstructure work, refining end usage and electric melting.

Multiple Course Construction

The use of several courses of blocks to build a side wall in a glass tank was quite common some time ago. Many glass tank operators have rejected this type of construction because of the fact that horizontal joints on tank side wall blocks have eroded to an extent surpassed only at the metal line. For this reason, large segments of the glass industry continue to use one piece tank blocks often as deep as 48 to 52". The major exceptions here are flat glass tank operators and most European glassware manufacturers.

However, electrically fused cast alumina refractories possess exceptional resistance to upward drilling and to joint erosion at both horizontal and vertical joints. Many commercial installations have indicated this statement to be true; and because of this characteristic, it is strongly urged that those segments of the glass industry not using two and three course construction give it considerable thought.

The question may be raised that in this type of construction, the number of casting vugs or scars is increased with a possibility of trouble due to voids or pipes in the blocks. Due to the composition and casting techniques employed, particularly by the use of a substantial hydrostatic head, this possibility has been greatly minimized. As a further safeguard, the actual weights of all blocks are checked against estimated weight before shipment. No difficulties due to increased number of vugs or scars have occurred in any commercial installations.

Rather, it is believed that several benefits may be obtained by the substitution of 2 or 3 blocks for a one piece tank block since, in most cases, maximum erosion takes place in the top 6" to 12" of tank blocks. These benefits, as realized by the use of a block resisting horizontal joint attack and upward drilling, are: 1) The replacement of the top course of blocks only after a campaign, with the subsequent re-use of lower course blocks for additional production. This results in the reduction of repair costs and a lessening of repair time with corresponding increases in production. Needless to say, it

eliminates the waste of from 50 to 75 per cent of a single course block which has eaten through at the metal line only. Experience indicates that the metal line blocks be approximately 18″ deep and 24 to 36″ long. In our experience we have not met a single glass tank operator who would not like to spend less money on refractories, and this presents a definite method of lowering annual refractory costs.

2) Chunky blocks, which are less subject to breakage and easier to handle, have a better crystalline structure. Along the same line, many redesigns of throats, directed toward the use of smaller, yet chunkier blocks, have proven successful commercially.

3) The amount of bearing surface remaining on the lower course blocks after an initial campaign is very important. A block only eroding an inch or so on its exposed face, but which cuts back 4 to 6″ on its supporting face, does not lend a stable base in the event of replacement of upper course blocks. This alumina product line has afforded a more than ample supporting surface in all commercial installations.

4) The practice of more economically balancing a tank by using various refractory materials, basing the choice on such factors as erosion resistance, purity, thermal conductivity and cost, should be considered.

This latter point, tank balance, is an especially important one to glass tank operators. It has long been the policy of tank operators to balance furnace construction by using blocks of varying erosion resistance vertically or along the length of a melting end side wall. Two or three course construction allows a further refinement by indicating a horizontal approach to side wall refractories.

Tank Balance

In discussing further this question of tank balance, it should be pointed out that in attempting to secure tank balance in the past, the tendency has been to strengthen the area under the first or second port, at the throat, and at the doghouse of a furnace with improved refractories. Lower grade refractories were used for the remainder of the tank. At that time, the highest temperatures were at the doghouse end of the tank.

However, design changes, technological advances and the use of better refractories have resulted in considerably higher production for most glass tanks. To properly fine a glass, high temperatures are required further down in the furnace. These increased temperatures will increase convection currents in the glass which, in turn, contribute to a need for even more improved refractories.

There are two basic concepts from which this question of tank balance may be considered. The first of these is to select refractories throughout the entire furnace that will fail at approximately the same time, thereby giving an equal life of refractory material throughout the furnace. The second is to design a furnace which may last for several campaigns with two or three major intermediate repairs. The recommendations presented herein are based generally on the second type of construction because of a belief that it is more economical in the long run, giving a lower cost of refractories and repairs per ton glass melted. We have conscientiously attempted to work with the glass industry in aiding in the selection of refractories for either concept of balanced tank construction.

In deciding between these two types of construction, the proper choice of refractory is a factor which must be carefully considered. To that end, glass tank operators and engineers should familiarize themselves with the new improved flux blocks, the various types of checker brick and the varieties of electric fusion products now available, and do this before selecting their refractories so as to obtain tank balance. Initial purchase economy should not greatly influence refractory selection, as a better balanced tank which will extend the average campaign and/or increase quality will more than offset any economic advantage shown on the initial purchase price.

Recommendations as regards types MH and K are based on two factors, erosion resistance and glass quality as influenced by refractories. From the doghouse end to the refining end of a tank, the selection of refractories is based on erosion resistance. From the refining end of the tank back to the doghouse, the selection of refractories is based on absence of refractory-caused rejects in the finished product. The recommendations for soda-lime glass, which include most flat and container items as well as other miscellaneous glasses, represent a considered judgment of these qualities of erosion resistance and the lowering of rejects. Average soda-lime compositions are not affected by either of these refractories as regards color contamination.

It is important to note here that type K will not cause color contamination in the average soda-lime glass. This product has often been referred to as "the block that has chrome and iron in it, but works well in spite of this." In reality, type K has chrome and iron present and is good because of it. Although the combined oxides of iron and chrome are strong colorants as such, these oxides are introduced into type K as the refractory mineral chromite and exists in the finished product as a chrome spinel. These interlocked spinel crystals, with alumina in solid solution, impart to this product superior erosion resistance.

For example, chromite crystals have been used, due to their inertness to the fluxes in glasses, to provide the abrasive surfaces for glass blackboards. From a mathematical standpoint, even if all of the interface formed were incorporated in the glass produced rather than settling to the bottom of the tank, it can be shown that the chrome oxide content of the final glass can only be measured in ten thousandths of one per cent.

In line with these thoughts on balanced tank construction, the following chart indicates general usage recommendations for the melting end proper.

		Melting End		
Type	*Doghouse*	*To 2d or 3d Port*	*Balance*	*Bridgewall & Throat*
Flat Glass	K	K	MH	MH
Flint Containers	K	K	MH	MH-K
Colored Glass	K	K	K	MH-K
Opal Glass	K	K	K-MH	MH
Borosilicate, Lead, Barium, Crystal	MH	MH	MH	MH

For the reasons outlined above, the same general recommendations for types MH and K are made as regards flat and container glass. These are based exclusively on erosion resistance and quality as influenced by refractories.

In colored glass, type K is recommended further toward the refining end of the tank because of the higher erosion resistance at the metal line. Since colored glass absorbs radiant heat to a lesser depth, higher temperatures are required resulting in more vigorous surface convection, which in turn leads to increased erosion at the metal line.

In this melting operation, it is believed that type K can be advantageously used at the metal line in conjunction with supporting clay blocks, as such a combination may be more economical. The use of clay here may be advantageous because of its lower thermal conductivity and the attendant possibility of slightly increasing the thermal efficiency of a glass tank. Type K at the metal line only resists the localized erosion experienced in melting colored glass, and will protect the supporting flux blocks.

Two points must be considered here. The first of these is that since a fused cast refractory has a higher thermal conductivity than clay, the joint between these blocks will be hotter. Some auxiliary cooling may be necessary at the first joint.

Secondly, the interstitial glass content of any fused cast refractory to be used over clay flux blocks must be considered as this glass may melt within the block and form eutectics with the clay block at the clay block's supporting face.

This is another reason why the amount and refractoriness of interstitial glass in a fused cast product is considered as being extremely important. As referred to previously, the interstitial glass content of this high alumina product line ranges from .5% to 1.8%, substantially lower than is believed present in other materials. As to the refractoriness of the small amount of interstitial glass in this line, no surface phenomenon indicating an "ooze" or boiling out of this glass was noted when studied under a thermal microscope in a range from room temperature through 2550°F. which also makes this group of refractories quite unique.

To return to the charted recommendations, the high fluorine content of opal glass results in increased erosion at the metal line. For this reason, the use of type K further down in the tank proper is recommended.

In specialized glasses, such a borosilicate, lead, barium, or crystal glasses, which are processed into high quality items selling at high unit cost as compared to the bulk of soda-lime glasses, type MH is recommended because of its combined purity and erosion resistance.

Superstructure

Before considering Superstructure, it is desirable to emphasize the three factors that have contributed to increased overall tank life, which are: 1) The use of high grade refractories supplied for the tank proper by fused cast refractory and flux block manufacturers. 2) Major engineering and technical advances in glass manufacturing. 3) Improved checkerbrick.

This increase in furnace life has resulted in considerable attention being given to the selection of refractories for the superstructure which is now a critical zone in many glass tanks.

Beta alumina (type H), which was developed especially for superstructure work, has been successfully utilized because of five key factors: 1) *Resistance to Spalling.* Containing over 99% alumina, type H is a one phase body that resists to a marked degree the stresses resulting from repeated temperature changes. Since the crystalline structure is relatively open and porous, the material can expand and contract slightly without introducing stresses and strains that might result in spalling.

2) *Refractoriness.* As an electric fusion product, this material has a fusion point above 3400°F., and can be safely used well above commercial glass tank operating temperatures. This quality of refractoriness is especially important in tanks melting colored glass or borosilicate glass.

3) *Low Percentage of Glassy Matrix.* Type H contains less than .5% interstitial glass. If this low amount of glass is leached out, it will not leave a "honeycombed" crystalline structure, which would tend to spall off into the bath, causing rejects due to stones.

4) *Chemical Inertness.* The possibility of eutectic formations with other refractories, volatilized alkalies and batch dust is avoided by the inertness and refractoriness of beta alumina and the practical absence of interstitial glass. Type H has shown no appreciable eutectic formations at normal operating temperatures when placed adjacent to, above or below other commercially available superstructure refractories.

5) *Thermal Efficiency Factors.* For a fused cast refractory, type H has the comparatively low thermal conductivity of approximately 23 BTU/hour/foot squared/inch/degree F. This indicates less heat transmission through the material than with other commonly used superstructure refractories whose thermal conductivity is approximately 30 units. Pure white in color, this product has a greater tendency to reflect radiant heat rather than to absorb it as darker or "black-body" materials do.

It is firmly believed that these factors of resistance to spalling, refractoriness, low glass content, chemical inertness and thermal efficiency as possessed by beta alumina, have contributed greatly to its successful utilization as breast wall blocks, tuck stones, port jambs, port sills, port arches, pyrometer blocks, burner blocks, baffle blocks and in port neck construction.

Refining End

Another section of a glass tank which is becoming increasingly critical from a tank operator's standpoint is the refining end. Type MH is recommended here because of: 1) The high purity of this product. 2) The proven erosion resistance of this material which should allow several campaigns use in the refining end of a tank, even though the melting zone and superstructure may be replaced or repaired several times in the interim. 3) The greatly reduced interstitial glass content of type MH as compared with other commercially available glass house refractories. 4) The practical absence of blistering which may occur upon release of air or gas bubbles to the melt when erosion takes place.

The first and second points indicated above are self-

(*Continued on page* 112)

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Feeding and Forming

Machine for Making Beads. Fig. 1. Patent No. 2,456,697. This patent was assigned to Novelty Jewelry Corporation of New York by Andrew Gruenwald also of New York. The invention may be used for making objects other than beads, but it is described as adapted for making beads having an aperture.

In the drawing, M. represents a motor driving a shaft 12 carrying a worm 14 in mesh with a gear 16 mounted on a shaft 18. This shaft carries a gear 20 which drives a gear 22 mounted on a shaft 24. A roller 40 is mounted on the shaft 18 and this cooperates with a roller 42 on the shaft 24. A series of cushioned dies 44 are mounted on the roller 40, the face of each die being shaped to form one half of the bead to be made. The roller 42 carries a series of dies 45 which cooperate with the dies 44 as the rollers are rotated.

The glass supply B passes downwardly through a pair of pressure rollers 110 so that a stream A comes between the dies 44 and 45. At the point P, a pin is advanced by a fixed cam to make the perforation in the bead. The dies are arranged to be moved toward each other so as to prevent premature chilling of the glass. The finished bead drops into a suitable receptacle for further treatment if desired.

The following references are of record in the file of this patent: United States Patents: 989,831, Burkhardt, Apr. 18, 1911; 1,493,044, Leiman, May 6, 1924; 1,537,348, Grossmann, May 12, 1925; and 2,359,798, Schumann, Oct. 10, 1944. Foreign Patents: 14,107, Great Britain, 1886; 188,463, Great Britain, Nov. 16, 1922; and 484,280, Germany, Oct. 12, 1929.

Miscellaneous Processes

Dealkalization of Glass Surface. Patent No. 2,455,719. This improvement in glass manufacture is the invention of Woldemar A. Weyl and Helen S. Williams of State College, Pa., who assigned it to "The People of the United States of America."

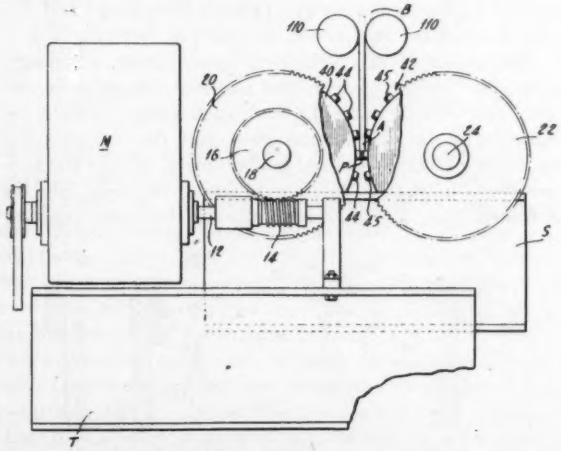


Fig. 1. Machine for Making Beads.

Alkali in the form of soda ash or sulfate is important in most glass batches but after the melting operation, the alkali remaining in the glass is undesirable in many respects. It is responsible to a large extent for the high thermal expansion of soda-lime glasses. It has a bad effect on glass fibers, and insulators made of soda-lime glass are not as good as those made of silica glass. In the manufacture of bottles, a decision must be made as to whether to increase or decrease the alkali content in view of the results, good or bad, to be obtained. This invention provides an improved method for dealkalizing the surface of glassware, particularly soda-lime glassware.

According to this invention, the surface of the glass is treated by coating it with a solid compound such as metakaolin (dehydrated kaolin; see Searle, The Chemistry and Physics of Clays, second edition, page 455) or similarly reacting substances. This treatment removes the alkali from the surface of the glass.

In carrying out this process, the surface to be treated is covered by a slip of kaolin in water so as to form a coating of about 0.5 mm. thick. When dry, the ware is heat treated somewhere between 200 and 400°C. in accordance with the character of the glass being treated. In some cases the temperature may be as high as 600°C. The patent gives complete information as to this process and it should be read by anyone interested in it. Numerous examples are given of which the following is the first.

Clay purified by electrodialysis was mixed with sufficient water to form a paste. This paste was applied to a portion of a normal soda-lime glass surface, using commercial mircoscope slides, so that comparison could be made of the treated surface with the untreated surface, and the paste was dried. The article was then heated for eight hours at 250°C.

After the article had cooled the clay was removed by washing. At this low temperature hydrogen ions from the clay or from the water film adhering to the glass surface exchanged with the alkali ions of the glass on the surface covered by the paste, thus forming a hydrogen glass of increased surface reactivity.

The hydrogen ions which have replaced the alkali in the glass surface enter base exchange reactions more readily than alkali ions in the same environment, as can be seen from the following test, in which the surface was treated with cuprous chloride. The glass article was placed in a covered container with a small amount of solid cuprous chloride and heated for eight hours at 450-500°C. The solid cuprous chloride volatilized, producing an atmosphere of cuprous chloride vapor. The cuprous ions replaced the hydrogen ions in the clay-treated portion of the glass surface. The glass article was then subjected to reduction in hydrogen at 400° for half an hour.

During this treatment the glass assumed a red color. The red color which developed on the portion of the glass which had been in contact with the clay was much more intense than the color formed at the untreated por-

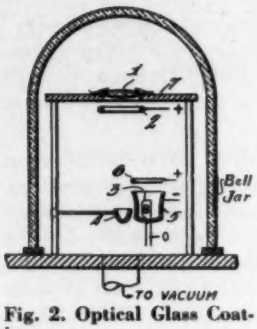


Fig. 2. Optical Glass Coatings.

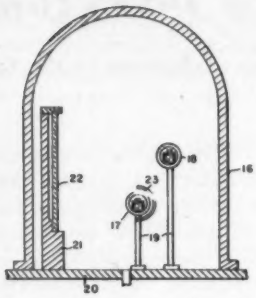


Fig. 3. Quartz coating for glass.

tions of the surface, thus showing that the clay treatment at the low temperatures of this example produces a glass surface which is more reactive than the untreated surface.

The gist of the invention may be summarized by Claim 2 which is as follows: The method of dealkalizing glassware surfaces which comprises coating the surfaces with an aqueous dispersion of a clay, drying the coated glassware, and heating the coated glassware to above 150°C. and below the softening temperature of the glassware to effect removal of alkali from the surfaces and combination thereof with the clay.

The following references are of record in the file of this patent: United States Patents: 254,263, Bitterlin, Feb. 28, 1882; 1,306,505, Veda, June 10, 1919; 1,328,833, Hasburg, Jan. 27, 1920; 1,555,852, Heidemann, Oct. 6, 1925; 1,592,429, Kraus, July 13, 1926; 1,698,302, Goss, Jan. 8, 1929; 2,034,987, Morita, Mar. 24, 1936; 2,184,316, Plummer, Dec. 26, 1939; 2,215,039, Hood, Sept. 17, 1940; 2,330,193, Blau, Sept. 28, 1943; and 2,348,704, Adams, May 16, 1944.

Optical Glass Coatings. Fig. 2. Patent No. 2,456,708. Edward W. Kellogg assigned this patent to Radio Corporation of America. The patent aims to improve the hardness and durability of coatings applied to reduce the reflection from optical lenses and things of that kind.

Magnesium fluoride has been used for this purpose, but difficulty has been encountered due to the necessary heat treatment. The coating of cemented lenses has been particularly difficult. This invention proposes to bombard the surface of the glass with high velocity electrons. The method has many advantages over any previously employed.

In Fig. 2 there is shown a collector electrode or ring 2 located near the lens 1 to be coated. The ring is located so that it will not obstruct the paths of molecules of mineral from a source 3 of electrons. The lens is supported on a plate 7. The collector 2 is at high positive potential with respect to the source or cathode 3. The mineral to be evaporated is placed in a crucible 4 which has heating means not shown. A directing ring 5 surrounds the cathode 3 to start the electrons in the right direction and an accelerating electrode or ring 6 may be used to help reduce space charge over the cathode 3. The conformation of the electrodes and the relative potentials are such as would be familiar to engineers engaged in cathode ray and television work. Examples are given in the patent. The electrical effects are rather complicated, but are well set forth in the patent.

The following references are of record in the file of this patent: United States Patents: 1,965,582, Faulke, July 10, 1934; 1,965,587, Faulke, July 10, 1934; 2,164,595, Siebertz, July 4, 1939; 2,178,233, Klatzow, Oct. 31, 1939; 2,239,642, Burkhardt, et al., Apr. 22, 1941; 2,281,638, Sukumlyn, May 5, 1942; 2,301,456, Sabine, Nov. 10, 1942; and 2,391,595, Richards, et al., Dec. 25, 1945. Foreign Patents: 510,404, Great Britain, Aug. 1, 1939.

Quartz Coating for Glass. Fig. 3. Patent No. 2,456,899. This patent was assigned to Libbey-Owens-Ford Glass Company by John D. Strong of Baltimore, Md., and it relates to a method of applying a coating of quartz to glass or other substances, such as mirrors where the coating reduces reflection and provides a hard covering which resists scratching.

The drawing shows an apparatus for carrying out this method of evaporating silicon monoxide or quartz in the presence of a solid silicon reducing agent and depositing a layer on the mirror or other article to be coated. A bell jar 16 is attached to a vacuum pump and its base 20 supports electric coils 17 and 18 upon stands 19. An article support 21 carries the mirror 22 to be coated.

The patent gives as an example, directions for the use of this apparatus in coating a mirror with quartz. 0.75 gram of silver was placed in the coil 17 and 0.24 gram of silicon monoxide in the coil 18. The glass 22 was placed at a distance of 12 inches. A hemispherical screen 23 was placed behind the coil 17 carrying the silver. The bell was then vacuumized to about 10 to the minus 5 mm. and the coil 17 was energized which deposited a coating of silver on the glass. At this time, the screen 23 protects the filament 18. The coil 18 was then heated and the silicon monoxide evaporated upon the silver coated glass. The article was then removed to the atmosphere and the deposit oxidized to a quartz coating, this coating and the silver coating each being about 0.0001 mm. in thickness. By proper operation, the quartz coating may be made as thick as desired.

The following reference is of record in the file of this patent: United States Patent: 2,386,876, Ogle, Oct. 16, 1945.

Method of Sealing Copper and Glass Tubing. Fig. 4. Patent No. 2,457,144. This patent relates particularly to the manufacture of vacuum and gaseous tubes where it is necessary to seal a copper tube onto a glass tube. The patent was assigned to the Federal Telephone and Radio Corporation by Lynn C. Goodale of Newark, N. J.

The object of this invention is to provide a stronger and more leakproof seal than has been common heretofore and also to make the seal more easily. This is accomplished by placing the glass and the copper tubes in contact while at normal temperatures, raising the temperatures until it is possible to force the metal into the softened glass and then withdrawing the metal tube for

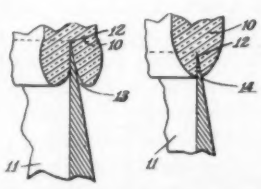


Fig. 4. Method of sealing copper and glass tubing.

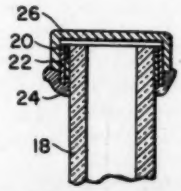


Fig 5. Vitreous bonding composition.

a short distance so as to reverse the meniscus.

The steps in this operation are clearly shown in Fig. 4, which is at the left, an enlarged section through one side of a seal with knife edge 12 of the copper tube 11 pushed into the softened glass 10 and at the right, after the tube 11 has been slightly withdrawn. The copper tube 11 is pushed into the glass only about 3/32 of an inch which forms a meniscus as shown at 13. During this operation a film of copper oxide is formed which makes a good seal with the glass. When the copper tube is slightly retracted, a meniscus as at 14 is formed which makes a much more satisfactory seal between the two parts.

The following references are of record in the file of this patent: United States Patents: 872,530, Meeker, Dec. 3, 1907; 907,489, Genese, Dec. 22, 1908; 1,627,780, Jonas, May 10, 1927; 2,010,145, Eitel, Aug. 6, 1935; 2,062,836, Scott, Dec. 1, 1936; 2,075,057, Richardson, Mar. 30, 1937; 2,125,315, Ronci, Aug. 2, 1938; 2,203,917, Mallory, June 11, 1940; and 2,288,537, Mallory, June 30, 1942.

Vitreous Bonding Composition. Fig. 5. Patent No. 2,457,158. This patent was assigned to E. I. du Pont de Nemours & Company by Daniel O. Koch of Rahway, N. J. The patent is a continuation-in-part of an abandoned application filed July 1, 1944. The term "vitrified ceramic" as used in this patent is understood to include various types of glass and also vitrified porcelains such as china, steatite, etc. The material here proposed is a new and improved silver-glass bonding composition for use in making a bond between various vitrified ceramic materials and between metal and glass or porcelain.

For use in bonding glass and a metal, the proportions between the silver particles and the glass particles should preferably be between 7:1 and 10:1, these figures being based on the weight of the flux and the weight of metallic silver contained in the silver particles. The quantity of the liquid vehicle may be varied as desired. This vehicle may be turpentine, varnish or several other materials.

Three examples of suitable glass fluxes are given in the patent, one being as follows:

	Per cent
PbO	72.0
B_2O_3	2.5
SiO_2	24.0
TiO_2	1.5
	100.0

When glass is being bonded, the firing temperature should be between 50°C. and 25°C. below the temperature at which the glass will be deformed. Firing for from 1½ to 4 hours is usually sufficient to produce a good bond. After firing, the surface is electro-plated with copper to give a surface readily wet by solder. A coat of tin may be applied over this or if the surface is highly burnished, solder may be applied directly. The usual soft solder may well be used. A glass to metal bond in accordance with this invention has produced a measured bond strength of 900 pounds per square inch.

Fig. 5 is a cross section of a glass tube bonded to a metal cap. The tube 18 has been treated as above described so as to provide a coating 22 of electro-deposited copper on the fired bonding composition 20. Solder 24 secures the cap 26 to the copper layer.

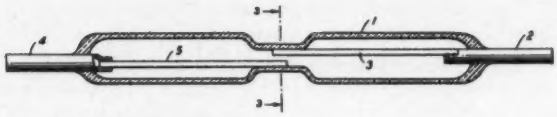


Fig. 6. Sealed contact device.

The following references are of record in the file of this patent: United States Patents: 617,299, Purinton, Jan. 3, 1899; 2,020,559, Malinovszky, Nov. 12, 1935; and 2,389,386, Russell, Nov. 20, 1942.

Sealed Contact Device. Fig. 6. Patent No. 2,457,218. Enoch B. Ferrell of Chatham, N. J., made this invention and assigned it to Bell Telephone Laboratories, Incorporated. The method of making this magnetically operated contact device is to first shape the glass envelope from a tube by inserting a mandrel of the desired shape, into the softened glass tube. Vacuum is then applied to the inside of the tube so as to draw the glass into contact with the mandrel to produce the desired shape in the inside of the tube. Reeds are then placed in the envelope and held by magnetic force while they are fused to the glass. This method of shaping the tube and holding the reeds while being fused into permanent position, produces a contact device having many advantages over those made by prior methods.

Fig. 6 is a section greatly enlarged of a finished contact device. The glass envelope 1 is first collapsed while heated to the softening point about a mandrel so as to form the constricted central portion while leaving the ends in their original tubular form. The reed 3 is welded to a rod 2, both parts being of magnetic material, and the opposite parts 4 and 5 are assembled in the same way. The rod 4 has an opening by which the envelope may be exhausted after completion. The envelope 1 is sealed at the ends to fasten the reeds in exact position, while the reeds are held in position by an external magnetic force. Obviously the mandrel used to shape the interior of the envelope must be made in two parts so as to permit withdrawal.

The following references are of record in the file of this patent: United States Patents: 2,125,316, Ronci, Aug. 2, 1938, and 2,187,115, Ellwood, et al., Jan. 16, 1940. Foreign Patents: 509,077, Great Britain, July 11, 1939.

Machine for Making Glass Film. Fig. 7. Patent No. 2,457,785. Games Slayter and Henry Snow assigned this patent to Owens-Corning Fiberglas Corporation. The film described can be used as a substitute for mica and it has several advantages over mica, one of which is that the film may be made in any desired size instead of in small flakes as found in natural mica. The

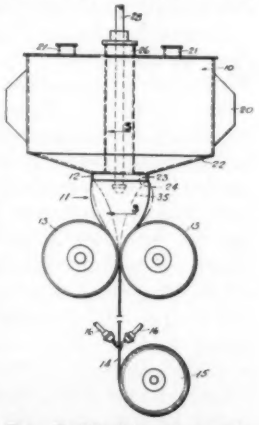


Fig. 7. Machine for making glass film.

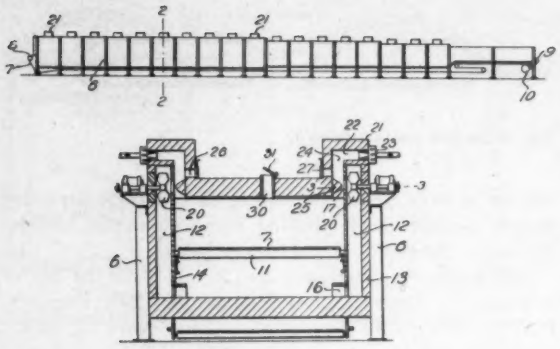


Fig. 8. Surface Combustion Corp. Lehr.

film is made by flattening a cylinder of very thin glass. This patent is a continuation-in-part of the co-pending application resulting in Patent No. 2,386,511 issued Oct. 9, 1945.

Fig. 7 gives a general idea of the machine which comprises a melter 10 from which a hollow stream 11 issues through the orifice 12. This stream is flattened between high speed rolls 13 to form a sheet of film 14 which may be wound on a spool 15 or cut into sheets. Lubricating material may be applied by spray heads 16 if desired.

The melter 10 is heated electrically by current applied to lugs 20 so as to melt the batch inserted through charging openings 21. The orifice 12 includes a ring 23 having a series of closely spaced openings 24 through which the glass issues to form the thin walled cylinder. Air pressure to the inside of the cylinder being formed is supplied by the pipe 28. As the bottom of the cylinder is closed by the rolls 13, this pressure expands the cylinder to form the thin walled bubble shown at 11. This expansion serves to equalize minor variations in the glass and its temperature. As a result, a very thin double walled film is formed which can be made of almost any size desired and, due to the double wall feature, is less likely to break permitting leakage.

The following references are of record in the file of this patent: United States Patents: 1,136,362, Pease, Apr. 20, 1915; 1,239,024, Manning, Sept. 4, 1917; 1,592,299, Howard, July 13, 1926; 1,750,972, Soubier, Mar. 18, 1930; 2,172,899, Barnard, Sept. 12, 1939; 2,243,194, Cook, May 27, 1941; and 2,342,891, Powers, Feb. 29, 1944. Foreign Patents: 483,843, Germany, Oct. 5, 1929.

Surface Combustion Corporation Lehr. Fig. 8. Patent No. 2,458,040. This is the invention of Harvey C. Weller of Toledo, Ohio. It relates to a direct fired (open fired) lehr where the products of combustion are in contact with the ware being treated.

The figure shows a side elevation of the lehr and a section on the line 2—2. The lehr comprises a frame 6 through which passes a perforate endless conveyor 7 having the return strand below the tunnel. This conveyor passes around rolls 8 and 9 and is driven by a drum 10. The belt is supported inside the tunnel by rollers 11, all in accordance with the usual construction.

At the sides of the tunnel, there are vertical ducts 12 between the walls 13 and 14. Each duct has a bottom outlet 16 and a top inlet 17 with a fan 20 for drawing the gases downwardly and returning them to the tunnel. Each duct 12 has a gas generator 21 including a burner 23 by which the temperature of the gas being circulated may be varied. An inlet port 26 provides for cooling when necessary. Excess gas is allowed to escape through flues 30 regulated by dampers 31. This construction provides means for controlling the temperature of the lehr and also obtaining vertical circulation of the gases.

The following references are of record in the file of this patent: United States Patents: 1,214,217, Plante, Jan. 30, 1917; 1,719,684, Besta, July 2, 1929; 1,837,311, Amsler, Dec. 22, 1931; 2,039,429, Lydon, May 5, 1936; and 2,275,263, Merrill, Mar. 3, 1942.

Tube Forming Method. Fig. 9. Patent No. 2,458,934. This invention was assigned to James A. Jobling & Co. Ltd., of Sunderland, England, by Samuel J. Everett of Thornton Heath, England. The patent was divided from the application resulting in Patent No. 2,393,979 issued Feb. 5, 1946. This method is particularly useful in the manufacture of cylinders for hypodermic syringes which must have an interior surface of exact and uniform dimensions.

In the figure, the left end of the machine is shown above with the right end below. The glass tube 1 being treated is supported between chucks 2 and 3 which travel along guides 4 and 5 so as to carry the tube through a furnace 6 where it is heated to the softening point. As the tube travels to the right, it is drawn over a former 7 carried by a rod 8 projecting through the chuck 2.

A vacuum pump 18 is connected to the inside of the tube 1 so that the softened tube is collapsed upon the former 7 and cooled sufficiently to maintain the exact diameter of the former. It is recommended that the former be made of pure silica, "Inconell" or stainless steel and that the inside of the tube be coated with colloidal graphite. The former is rotated at about 79 r.p.m. by a motor 19.

The chuck 2 is driven by connections to a lead screw 24 while the chuck 3 is driven by the lead screw 27. Means are provided so that the travel of the chuck 3 can be adjusted at various speeds faster than the chuck 2. This stretches the tube while it is collapsed and passing over the former 7. The wall thickness of the tube is reduced during this treatment and the length of the tube is usually about doubled. The internal diameter of the tube has

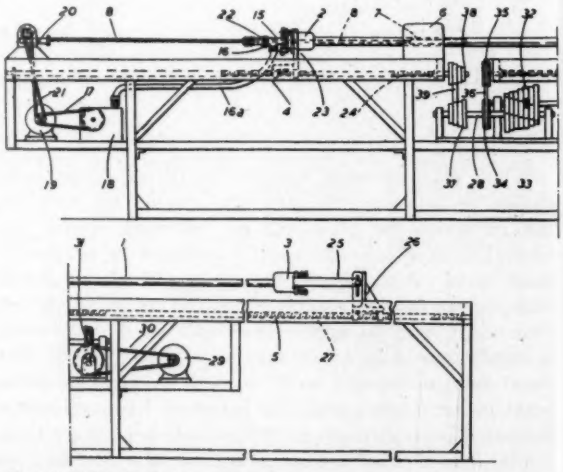


Fig. 9. Tube forming method.

been reduced and brought to an exact and uniform diameter.

The following references are of record in the file of this patent: United States Patents: 1,301,714, Kueppers, Apr. 22, 1919 and 2,393,979, Everett, Feb. 5, 1946. Foreign Patents: 241,544, Great Britain, Apr. 1, 1926 and 360,340, Germany, Oct. 2, 1922.

Glass Wool & Fiber

Method of Making Fibers. Patent No. 2,457,775. Owens-Corning Fiberglas Corporation acquired this patent from the inventor, Paul Ebaugh of Cambridge, Mass. The patent relates particularly to the application of a coating to the fibers. Such fibers are usually gathered into a stand and wound onto a drum. One such method is shown in Patent No. 2,234,986 to Slayter and Thomas.

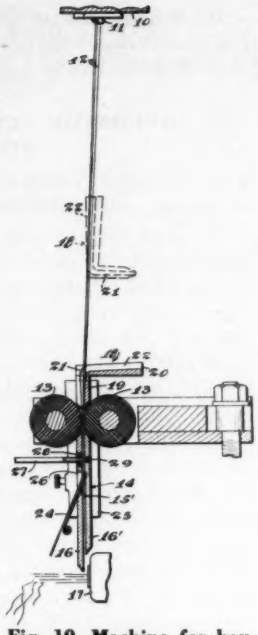


Fig. 10. Machine for handling fibers.

It has been customary to apply a coating to the fibers in order to prevent breakage but great difficulty has been encountered due to the high speed of the fibers and the very short time in which the coating must become effective. The coating compositions of this patent can be applied to fibers made at the rate of from 10,000 to 20,000 feet per minute. The patent gives eight examples of compositions coming under the patent, each of which varies slightly. The first example is as follows:

	Per Cent
Polystyrene	2
Mineral oil	13
Toluene	50
Stoddard solvent[1]	35

The following references are of record in the file of this patent: United States Patents: 378,411, Block A.P.C., Apr. 20, 1943; 1,792,102, Lawson, Feb. 10, 1931; 1,862,565, Burke et al., June 14, 1932; 1,997,337, Malm et al., Apr. 9, 1935; 2, 133,238, Slayter, Oct. 11, 1938; 2,142,668, Bucy, Jan. 3, 1939; 2,148,381, Slauter et al., Feb. 21, 1939; 2,209,850, Shand, July 30, 1940; 2,224,274, Powers, Dec. 10, 1940; 2,234,986, Slayter, Mar. 18, 1941; and 2,319,051, Fordyce et al., May 11, 1943.

Machine for Handling Fibers. Fig 10. Patent No. 2,457,777. William F. Holtschulte of Newark and Samuel D. Philipps of Granville, Ohio, made this invention and assigned it to Owens-Corning Fiberglas Corporation. The patent relates to the manipulation of the fibers after forming rather than to the actual formation of the fibers.

It has been the practice heretofore to thread each fiber separately by hand into a guide when the operation was started. This required a lot of time and the waste of material while the operation was being performed.

In Fig. 10, 10 is a glass feeder having a series of spaced orifices 11 from which fibers 12 harden as they pass downwardly and then pass between driving rolls 13. The fibers then pass to a stationary guide 14 having laterally spaced channels 15′ which lead the fibers into closer spacing. The fibers then pass into the flame of a high temperature and high velocity burner 17 which makes the fibers into extremely fine staple-like fibers.

After leaving the feeder, the fibers pass to a device 18 comprising a plurality of grooves 21 corresponding in number and spacing to the channels 15′ in the guide 14. In starting the apparatus into operation the device 18 is first removed from the position shown so that the operator can introduce the fibers directly to the rolls 13. The device 18 is then placed into contact with the fibers near the orifices 11 and then moved downwardly into the position shown in dotted lines. This guides the fibers into proper position to be received by the channels 15′.

The following reference is of record in the file of this patent: 649,489, Germany, Aug. 27, 1937.

[1] Stoddard solvent is, by the Bureau of Standards specifications, a petroleum distillate, clear and water-white, having a flash point not lower than 100° F. (by the "Tag" closed test-ᴛ), and the distillation end point of which is less than 410° F.

G-E ANNOUNCES NEW LAMP INSIDE FINISH

A new inside finish for incandescent lamps has been announced by General Electric Company's Lamp Department who describes it as "the most outstanding improvement in filament lamps since the introduction of the first successful inside-frosted lamp in 1925."

The special white finish is a silica substance which acts as a nearly perfect diffuser of light, yet permits high light transmission, according to the announcement. The finish is being introduced in three new lamp bulbs, a 100-watt lamp, a 100-200-300-watt three-lite lamp and a 150-watt indirect-lite lamp.

OPTICAL SOCIETY WINTER MEETING

The Winter Meeting of the Optical Society of America will be held at the Hotel Statler in New York City on March 10, 11 and 12. A special feature of the meeting will be a symposium on luminescence to be held on the first day of the meeting under the guidance of Dr. G. R. Fonda, General Electric Company. The symposium will be highlighted by two invited papers, "A Survey of Present Methods Used to Determine the Optical Properties of Phosphors," by Dr. W. B. Nottingham, Massachusetts Institute of Technology, and "Review of the Interpretations of Luminescence Phenomena," by Dr. F. E. Williams, General Electric Company.

The sessions for contributed papers on March 11 and 12 will be preceded by the following invited papers: "The Ruling of Large Diffraction Gratings," by Dr. G. R. Harrison, Massachusetts Institute of Technology, "Measurement of Size and Shape of Large Molecules by Light Scattering," by Dr. P. Debye, Cornell University, and "A Color Translating Ultraviolet Microscope," by Dr. E. H. Land, Polaroid Corporation.

The usual informal dinner will be held on Friday evening, March 11. The after-dinner program will consist of a demonstration lecture on "New Horizons in Lamp Research," by Alston Rodgers of the General Electric Company.

Benjamin Wood, Director of Marketing of the G.C.M.I. and principal speaker at the Glass Day luncheon, talks with Rudolf Pabst, Vice President of the Pabst Brewing Company, J. P. Levis, President of Owens-Illinois Glass Company, and Frank B. Pollack, President of Thatcher Glass Manufacturing Company.

GCMI MERCHANDISING PROMOTION PLANS OUTLINED AT SALES CLUB MEETING

Executives of glass container manufacturing companies were guests of honor at the January 11 meeting of the New York Sales Executives Club. Benjamin Wood, Marketing Director of the Glass Container Manufacturers Institute, was the featured speaker at the meeting.

Mr. Wood described for the sales executives the $1,500,000 merchandising campaign now being conducted by GCMI. The glass container industry, he said, after having accomplished miracles in production technique and volume, is now turning its attention to market research and promotion. As examples of the work being done in the program, he cited investigations and campaigns now under way in the milk, baby food and beer fields.

In the milk industry, the Institute is undertaking a comprehensive study of markets, consumer attitudes and costs at every stage of dairy operation. "We expect one of these days to be able to show the dairyman how, when and where the glass milk bottle may be used to his best advantage," Mr. Wood said. The bulk of the milk business still belongs to the home distributor and the glass bottle, he pointed out, and the bottle is still averaging 33 trips.

Baby foods, representing a yearly sales volume of $150,000,000, are already 70 per cent in glass, he said, and the Institute has prepared advertising and promotion plans which it expects to expand the market to its full potential.

Two-thirds of all beer sold today is in cans and bottles, Mr. Wood reported, with the bottle having 87 per cent of the package business. Though the returnable glass bottle, with its 16-trip life, is still the most economical package, greater distribution through food stores is steadily increasing the demand for a one-trip container as a convenience package. The promotion of the One-Way glass bottle, now only eight months old, has shown highly encouraging results and the industry believes the use of this package will continue to grow at an increasing rate.

He also called attention to the use of a one-trip bottle for carbonated beverages, principally in the 32-ounce size. This development is still in its initial stages.

OVERTIME SUITS AGAINST L-O-F DISMISSED

Three so-called "portal-to-portal" overtime suits filed by employees in Toledo plants against the Libbey-Owens-Ford Glass Company in 1946 have been dismissed by Judge Frank L. Kloeb in U. S. District Court wiping out the last of such claims against the company.

The suits were filed by Henry Wingart and others asking $1,900,000, by Alvin Ritzman and others seeking $3,000,000, and Charles Forman and others asking $2,000,000, and each suit asked liquidated damages in equal amount plus attorney fees.

The Court, in dismissing the suits, referred to his opinion issued at the same time in the case of Babione against Pure Oil Company, listing action taken by many other courts considering similar cases.

"It does not appear from the pleadings that plaintiff employees are within the exception of the Portal-to-Portal Act in that they were entitled to compensation for Portal-to-Portal activities by either contract, custom or practice during the time for which compensation is claimed," declared the court.

Judge Kloeb, in his opinion, said he assumed the Portal-to-Portal Act of 1947 to be constitutional and held that it applied to the cases before him. Previously, Federal Court at Newark, N. J., dismissed a blanket suit covering several Libbey-Owens-Ford plants involving a claim for $18,000,000 in portal pay.

UNION PACIFIC OFFERS SIMPLIFIED BOOKLET ON RATES AND CHARGES

As is common knowledge, the method followed by the railroad in tariff publication of the several increases in freight rates and charges that have been authorized by the Interstate Commerce Commission since early in 1946 has resulted in not only a good deal of confusion in determining the measure of presently applicable rates, but involves the examination of numerous freight tariffs.

From the standpoint of industry traffic departments who have the responsibility of verifying the rates assessed by the railroads, this is an altogether unsatisfactory situation and one that the Interstate Commerce Commission is now insisting be corrected.

In a memorandum published November 15, 1948, in the form of a 62-page booklet by the Union Pacific Railroad Company, there is shown by tables, charts and in an unusual map a simplified explanation of the proper method of using and interpreting present freight tariffs.

Until such time as the railroads simplify their tariff publications, the glass manufacturing industry will find this booklet of value in short-cutting the time required to determine correct freight rates to be applied.

The booklet may be obtained without cost by applying to the Freight Tariff Department of the Union Pacific Railroad, 15th and Dodd Streets, Omaha, Nebraska.

• The 18th Annual Meeting of the Porcelain Enamel Institute will be held October 27 and 28, 1949, at French Lick Springs Hotel, French Lick, Indiana, according to the Institute's headquarters.

GJ Research Digest

A Note on Very Soft Glasses and Some of Their Electrical Applications

This investigation, described by Dale and Stanworth (*Journal of the Society of Glass Technology*, June 1948) began as a result of a suggestion that a useful technique in valve and lamp construction would be one in which glass parts could be joined together using a soft glass enamel without deformation of the glass parts themselves. As a result of this investigation, suitable glasses (termed "solder glasses") have been developed for this "solder sealing" technique which is in marked contrast to the normal method of sealing by fusion.

To be satisfactory, solder glasses must fulfill the following conditions: a) They must flow at temperatures at which the glass parts to be joined are not deformed. b) They must be sufficiently durable to withstand normal storage conditions, the methods of application and the conditions of use. c) They should melt easily and uniformly, remain glassy at the temperature at which the seals are made and should "wet" satisfactorily the materials to be joined. d) Their expansion properties should match those of the glasses to be sealed together.

A study of the literature and of general enameling practice indicated that a study of the lead-borate glasses might prove promising and several glasses, therefore, were melted covering the range 50—90 per cent PbO (the remainder being mainly boric oxide) and their physical properties (expansion coefficient, deformation temperature and durability) were measured. Their durability, as measured by subjecting discs of these glasses to a warm moist atmosphere, was unsuitable for the intended use, all samples undergoing a high degree of attack.

In view of this result, other borate glasses were considered. The alkali borates have very poor durability and were obviously unsuitable. The borates containing the alkaline-earth oxides would be expected to increase in hardness in the order barium, strontium, calcium and magnesium, a fact which was confirmed by a study of the literature and by preliminary melts. It was also known that the possibility of introducing high percentages of these oxides into boric oxide increases in the reverse order making it seem worthwhile to investigate the barium borates. For the same reason, it was considered that the zinc borates would be worthy of consideration.

The simple glasses in the barium and zinc-borate systems are obviously too hard for the present purpose and the glasses in the simple lead-borate system are not sufficiently durable. It was necessary, therefore, to investigate borates containing more than one metallic cation, for example, the lead-barium and lead-zinc borates. A later paper will give detailed results of these investigations, but it is stated that glasses in these systems may be made with considerably improved durability. The inclusion, in addition, of a small percentage of silica gives further improvement in durability without undue increase in hardness.

A major problem was that of devising a "solder" glass which could be sealed to the standard soda-lime-silica glass bulb and to the alkali-lead oxide-silica glass base of miniature valves (Glasses C19 and C12, respectively). Stress measurements were made on sandwich seals of these glasses and the solder glass in order to determine the degree of match among the three glasses. The sandwich seals were produced by melting down a disc of the solder glass on to a disc of either C19 or C12 glass in an electric furnace at 550°C. cooling and reheating to 550°C. with a C19 or C12 disc on top of the solder glass. The seals were annealed by cooling in the furnace at approximately 2° per minute. It was found possible to develop solder glasses that showed a very good match with the C19 and C12 glasses.

Use is being made of the solder-glass technique in the production of miniature valves where the lead-glass base is joined to the soda-lime-silica bulb without distorting the base, thereby ensuring that the metal leads maintain their correct alignment during sealing. The technique also finds application in certain electronic devices where mica must be sealed to a metal or to a glass. Thus, a mica window may be sealed to a nickel-iron (containing 50-52 per cent nickel) plated with silver, copper, chromium or nickel by simply placing the mica in position on the nickel-iron, spreading a small quantity of glass powder around the edges of the mica and placing the assembly for a few minutes in an electric furnace running at about 500°C. Both mica and metal are wetted by the glass and, provided the glass has been designed to match the metal and the assembly is suitably annealed (by cooling at, say, 5° per minute), a perfect seal results. By means of a similar technique, a mica window may be sealed to the end of a soda-lime-silica glass tube. An interesting example was illustrated in which a tube of glass is sealed to a mica window at one end, a flat glass window at the other and a sheet of nickel-chromium-iron alloy forming a sealed diaphragm, all the seals being made with solder glass.

The Reduction of Cobalt in Glass

Cobalt, as a coloring ion, can enter a glass either in the position of network former or of network modifier. In the position of network former (coordination CoO_4), the well known blue color of silicate glasses containing cobalt oxide develops. Under certain conditions, it is able to enter the network modifier position (coordination CoO_6) and the red or pink color of aqueous solutions of cobalt salts appears.

Fanderlik and Schill (*Journal of the Society of Glass Technology*, June 1948) record some results which indicate the possibility of melting glasses under strongly reducing conditions to obtain the cobalt also in atomic form or as a pyrosol. Glasses produced under these conditions have an absorption spectrum different from that of normal cobalt-blue glass.

In the first series of glasses examined, iron oxide was

(*Continued on page* 106)

DR. E. W. TILLOTSON RECEIVES BLEININGER MEMORIAL AWARD

Dr. Edwin Ward Tillotson, Assistant Director of Mellon Institute, has been selected as the recipient of the Bleininger Memorial Award of 1949. This award is the highest honor conferred in this country for "distinguished achievement in the field of ceramics". Dr. F. L. Bishop, Chairman of the Pittsburgh Section of the American Ceramic Society, presented the award.

Formal presentation, symbolized by a medal and scroll will be made with appropriate ceremony at Hotel Schenley in Pittsburgh on March 11.

Dr. Tillotson's record of achievements goes back almost forty years when, at the University of Kansas, he conducted scientific investigations on the physical properties of glass. His work on the surface tension of glass was the first to be carried out in this country.

Dr. Tillotson joined Mellon Institute as a member of the executive staff in 1913 and has been for many years and is now in supervisory charge of all the Institute's investigations of the ceramic and related fields.

Active for many years in the affairs of the American Ceramic Society, Dr. Tillotson served as Vice President in 1922 and as President in 1926. He was Secretary of the Glass Division from 1919 to 1921, and served for several years as an associate editor of the Journal of the American Ceramic Society. In 1931, he became by election a Fellow of the Society, and in 1937, he was made a Fellow of the British Society of Glass Technology. In 1943, he was Honorary Chairman of the 45th Annual Meeting of the Society.

BUREAU OF STANDARDS ISSUES OPTICAL GLASS CIRCULAR

Information on the transmissive properties of most of the widely distributed makes of tinted lenses is now available in a new circular, Spectral-Transmissive Properties and Use of Eye-Protective Glasses, recently issued by the National Bureau of Standards.

The publication is the result of a story of the spectral-transmissive properties of about 200 glasses intended for use either as sun glasses or in special industrial operations where injurious amounts of radiant energy are present. Extensive consideration is given to elimination of glare, color distortion, use of glasses for night driving, standardization of glasses for outdoor and industrial purposes and the spectral-transmissive properties of glasses for use under various types and intensities of ultraviolet, luminous and infrared radiation. It is proposed that sun glasses be grouped into three or four shades having luminous transmittances of 60, 35, 25 and about 10 per cent respectively, values that correspond roughly to those for the industrial shades numbered 1.5, 2.0, 2.5 and 3.0.

This Circular C471 may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at the cost of 20 cents.

REFRACTORIES STUDIED BY FELLOWSHIP STUDENTS

In the interest of furthering the training of technologists for the refractories industry, the American Refractories Institute has sponsored fellowships for worthy graduate students who are interested in the study of problems relating to refractory materials. Eight fellowships on refractories have been established at universities having ceramic departments.

Richard L. Allen, Research Foundation at Ohio State University, is investigating the influence of very high forming pressure on the porosity, density and strength of refractory compositions containing high percentages of coarse non-plastic materials. Henry C. Brassfield, at Missouri School of Mines and Metallurgy, is studying the behavior of titanium dioxide on silica brick during burning, as a catalyzer, to convert quartz to cristobalite and tridymite. X-ray spectrometer data on fired samples, as well as those obtained during heating, are to be used to evaluate the extent of the conversion.

William E. Brown, in the School of Ceramics at Rutgers University, is engaged in learning of the part played by alkalies on the refractoriness of siliceous fireclay brick. Use is to be made of the hot load test to study the effect of these fluxes when added to alkali-free mixes. William D. Fitzpatrick, in the Ceramic Engineering Department of the University of Illinois, is conducting an investigation on some of the effects of the glass phase present in certain refractory compositions.

J. Raymond Hensler, in the Division of Ceramics at The Pennsylvania State College, has been engaged in the study of electrical resistance of refractories at elevated temperatures. Later he expects to measure this property, up to practical temperature limitations, on commercial and laboratory-prepared refractories, the maximum temperature of the equipment to be of the order of 3600 F. William D. Kingery, of Massachusetts Institute of Technology, is investigating certain orthophosphate cements for use in refractory compositions by studying the mechanism of setting, their bonding properties, and the effect of heat on their stability. Later, an attempt will be made to correlate the setting action with atomic structure.

Robert A. Morgan has studied in the Division of Ceramics at The Pennsylvania State College certain phase relations of the system beryllia-alumina-silica which are of interest to ceramists and metallurgists, the results of which are being prepared for publication. Hugh H. Wilson, Jr., in the Department of Engineering Research of North Carolina State College, is determining the hot load-bearing characteristics of silica-clay refractory compositions made from selected raw materials prepared with controlled grain sizes.

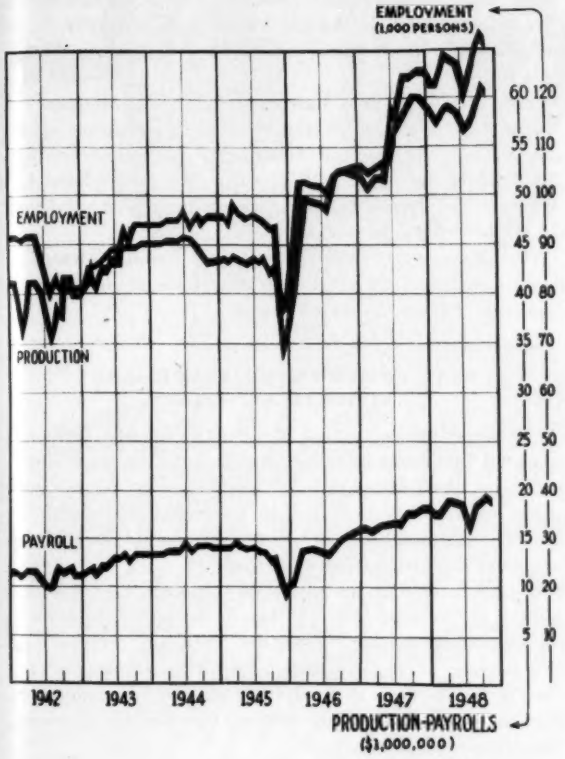
B. F. GOODRICH CHEMICALS PLANT

The first unit of the new $3,000,000 general chemicals manufacturing plant of B. F. Goodrich Chemical Company at Avon Lake, Ohio, is scheduled to start operations in the second quarter of this year, it has been announced.

New plasticizers for vinyl and synthetic resins will be the first products made in the new plant and trial quantities of the new plasticizers have already been made available to industry.

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX



The Production Index for the month of November 1948 shows a drop of 3 per cent, or an estimated total of $69,350,000, over the previous month's production figure of $71,500,000. Activity in the glass industry during the month of November 1947 was estimated at $64,750,000, or 7 per cent below November this year. Total glass output for the January-November 1948 period has reached an estimated $710,150,000, as compared with $656,250,000 estimated production during the corresponding period in 1947—a difference of about 8 per cent.

Employment and payrolls: Employment during November 1948 was reported to be 121,800. During October 1948, employment was 123,200, which is about 1 per cent above November. During November 1947, the number of persons employed was 120,000, or 1½ per cent below November this year.

Payrolls for the month of November 1948 were estimated to be $19,000,000, or close to 3 per cent below the estimated $19,750,000 reported for the previous month. During November 1947, payrolls were an approximated $18,500,000, which is about 8 per cent below November this year. During the January-November 1948 period, glass manufacturers have paid out an estimated total of $189,000,000 in payrolls, as compared with $185,000,000 paid out during the corresponding period in 1947. This represents a difference of about 2 per cent.

Glass container production: Compilation of national totals of glass container production and shipments for December 1948 was not complete when this issue of THE GLASS INDUSTRY went to press. Not all companies had reported due, probably, to year-end inventory taking.

We regret the omission of this important regular feature. It is likely that the December report will be completed and in our hands by the time this issue reaches readers. It will be published in March, along with the January figures.

In the meantime, THE GLASS INDUSTRY will be glad to answer all requests for December figures and tentative grand totals for 1948. Write, wire or telephone THE GLASS INDUSTRY, Editorial Department, 55 West 42nd Street, New York, N. Y. LOngacre 3-1521.

Automatic tumbler production continued on the down-grade to reach a December figure of 4,950,746 dozens. This is almost 8½ per cent below the November production figure of 5,398,091 dozens. Production during December 1947 was 4,944,176 dozens. Shipments also continued to fall off and were also about 8½ per cent below the previous month's totals: 4,463,188 dozens shipped during December and 4,873,089 dozens shipped during November. Shipments during December 1947 were 4,598,957 dozens. Stocks on hand at the close of December 1948 were 8,245,303 dozens, as compared with 7,662,498 dozens on hand at the close of November and 8,923,753 dozens on hand at the close of December 1947.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware continues its decline. Sales for the month of December 1948 were 2,843,956 dozens, which is close to 12 per cent below the previous month's sales of 3,225,191 dozens. Sales during December 1947 were 3,421,535 dozens. Manufacturers' sales for the 12-month period of 1948 totalled 41,105,839 dozens as compared with 42,355,874 dozens. This represents a decrease of 3 per cent this year from 1947 sales.

The figures for automatic tumbler production and sales of table, kitchen and household glassware of one manufacturer are estimated due to this company's inability to meet THE GLASS INDUSTRY's deadline. However, the totals for this concern have been estimated in order to complete the compilation of total industry figures. These total figures will be adjusted in the next issue of THE GLASS INDUSTRY.

• The February meeting of the Pittsburgh Section, American Ceramic Society, will have as its theme, "Mellon Institute Night". The meeting will be held on Tuesday, February 8 in Mellon Institute Auditorium, and will be preceded by dinner at the Royal York Hotel.

A series of talks on the various phases of ceramic research being conducted at Mellon will be given by those holding Fellowships.

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ANNIVERSARY PROGRAM AT OHIO STATE SCHOOL OF MINERAL INDUSTRIES

The program for the 75th Anniversary of the School of Mineral Industries at Ohio State University was varied and of considerable interest.

On January 24, speaker Hobart M. Kraner, Bethlehem Steel Corporation, presented "New Horizons in Ceramics," and J. B. Austin, Director of Research, U. S. Steel Corporation, spoke on "New Horizons in Metallurgy."

The following day Maurice D. Cooper, Manager of Vocational Training, National Coal Association, spoke on "Where Are We and Where Are We Going in Mining," while the subject "Where Are We and Where Are We Going in Petroleum" was presented by W. L. McCloy, Jr., Ohio Petroleum Comany.

On January 26, John D. Sullivan, Battelle Memorial Institute, chose as his subject, "The Role of the Mineral Industries in the National Economy."

NEW PERFORATED FIBERGLAS ACOUSTICAL TILE

A light-weight, perforated accoustical tile has been announced by Owens-Corning Fiberglas Corporation which is to be available April 1. Composed of compressed glass fibers, the new tile is noncombustible and its high sound-absorbing properties are supplemented by excellent thermal insulation value.

Weight of the tile is approximately seven-tenths pound per square foot. It can be cemented to a solid backing or mechanically mounted on wood or metal furring strips, or on suspended ceilings. Because of the tile's low density, it is possible to achieve high acoustical efficiency with only 196 three-sixteenths-inch-diameter perforation per square foot.

The tile is unaffected by humidity conditions and will not warp, buckle, expand or contract. It can be cut with a knife to special size or shape. The sealed surface, white in color, and the comparative small number of perforations, make the tile easy to repaint when necessary.

KIMBLE EXPANDS TELEVISION BULB MANUFACTURING

With the reopening of the Columbus, Ohio, Owens-Illinois Glass Company plant, Kimble Glass Division will expand its television bulb manufacturing operations and other glass production. The plant has been idle since June 1948 and is being made ready for the new operation by Kimble Glass. Some experimental operations will be under way in February, but the plant should be in full operation by May 1.

According to the company's announcement, the Columbus expansion has been made necessary by the tremendous market for the 10-inch and 12½-inch television bulb, which has multiplied more than ten times since February 1948.

• Pennsylvania Salt Manufacturing Company has announced the opening of a new District Sales Office in Appleton, Wisconsin. C. H. Anderson, of the company's Chicago office, has been placed in charge as District Sales Manager.

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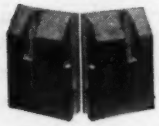
Retain shape longer for continued, more accurate control of glass gob.

BONUS-BUILDING ORIFICE RINGS—Retain shape and size for longer runs without costly replacement shutdowns.



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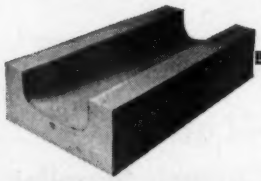

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RESEARCH DIGEST . . .
(*Continued from page* 101)

present both as Fe_2O_3 and FeO, together with a small amount of cobalt oxide. Silicon was used as the reducing agent in the batch. The transmission results do not agree with either the coordination $[CoO_4]$ or with that of $[CoO_6]$. In order to determine the spectral character which may result from the simple addition of the absorption of the cobalt ion of coordination $[CoO_4]$ and that of the Fe^{2+} ion, two glasses were melted, the first containing iron with silicon as a reducing agent and the second containing cobalt only. The theoretical absorption curve for the combination of these two glasses is totally different from the curves for the glasses containing the two oxides together and reduced with silicon. This means that the use of elementary silicon results not only in the reduction of Fe^{3+} to Fe^{2+}, but also in a substantial change of the nature of the Co^{2+} present in the glass.

In order to determine the properties of a glass containing only the Co ion and melted under reducing conditions (addition of silicon), the following glass was melted: SiO_2 73.5 per cent, CaO 9.2, Na_2O 17.4, CoO 0.014, Si 0.5.

In 2mm. this glass was of pure reddish-brown color in transmitted light, while in reflected light there was visible a strong Tyndall effect, the observed color being bluish gray. The brown color is not absolutely constant. A quenched sample of the melted glass was clear and in a thickness of 3mm. was greenish light gray in color by transmitted light. An annealed 10mm. thick plate showed in transmitted light the reddish-brown color and a vigorous Tyndall effect. Further heating to the softening temperature increased the opacity and the color in transmitted light became dark brown.

In the ultramicroscope, the glass showed particles like the gold ruby glasses. The glass is magnetic. The character and properties of this glass indicated that probably elementary cobalt existed in the form of a pyrosol. For a fuller characterization of cobalt pyrosols, further study of glasses containing cobalt oxide and melted under different reducing conditions would be necessary.

BROWN INSTRUMENT SCHOOL 1949 PROGRAM

Brown Instrument Company has announced that the industrial instrument maintenance and repair courses will be divided during the first six months this year into four classes of five weeks each and longer courses for company personnel.

In announcing the broadening of its instruction, M. J. Ladden, Head Instructor of the school, made known that the course for company personnel will start February 21. It will be sub-divided into specific classes for instruction in millivoltmeters, mechanical pyrometers, continuous balance electronic potentiometers, electrically operated automatic control, flow meters, thermometers, pressure gauges and hygrometers, air-operated control, Moist-o-Graphs, tachometers, resistance thermometers, CO_2 and analygraph. The five-weeks classes will continue through to June 17.

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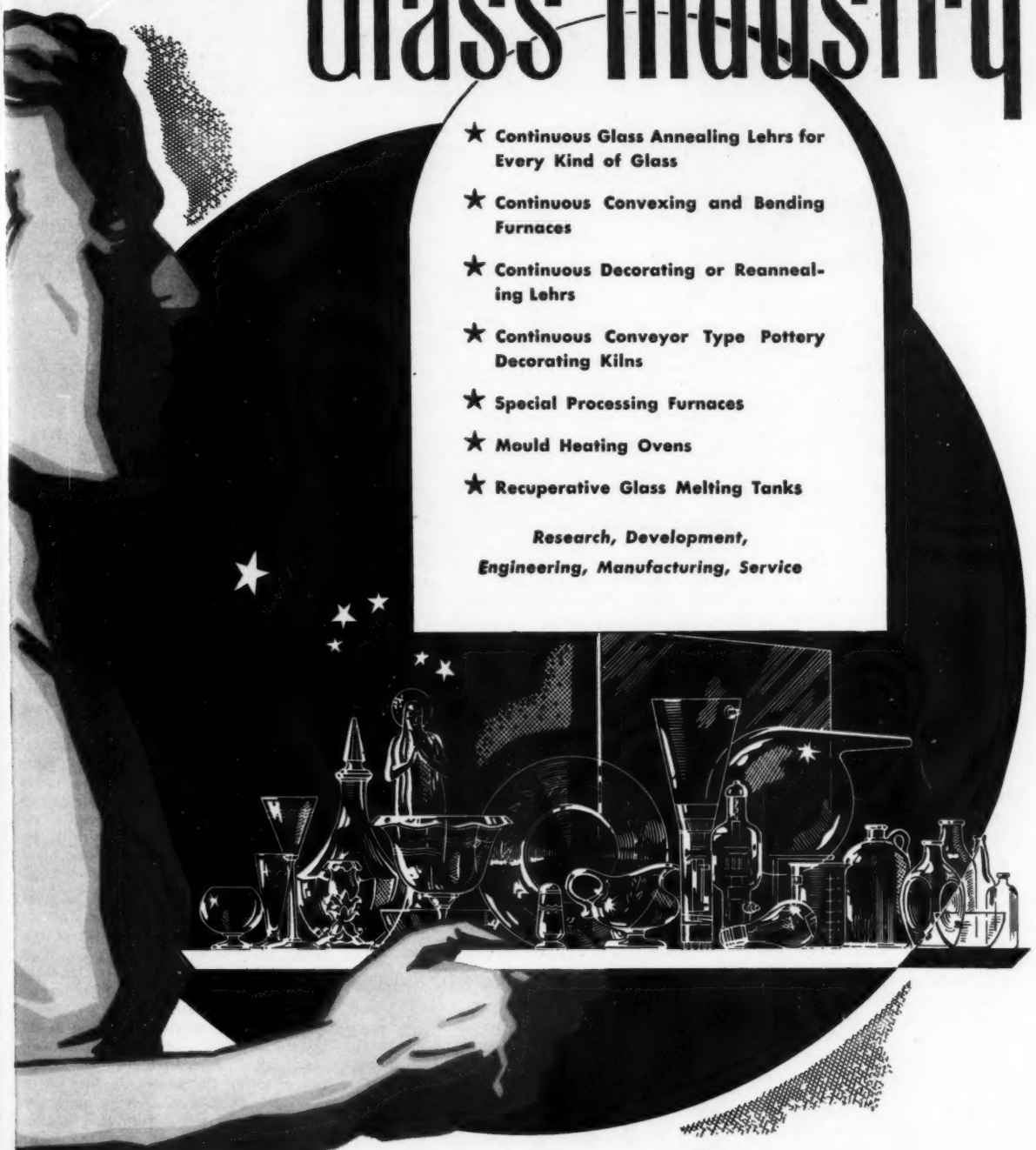

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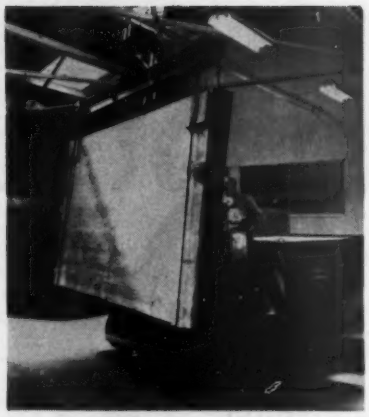


INDUSTRIAL TRUCK FOR HANDLING PLATE GLASS

Elwell-Parker Electric Company, Cleveland, Ohio, has announced a new type of power industrial truck to handle large packs of plate glass. Packs of plate glass generally comprise 25 sheets, ¼" thick, 75 x 145½"; weigh about 6000 pounds, loads varying according to gage and areas. The new truck has capacity for 10,000 pounds.

An established method of handling glass in factories and warehouses is by assembling the sheets on A-frames mounted on skids, and picking up these by means of trucks having long, low-lift platforms. A pack of glass on each side of an A-frame, leaning inward toward the top of the frame, gives a well-balanced load. Considerable manual handling has been required in assembling the sheets of glass on the frames, or removing them in warehouses and shipping rooms. With the new truck, packs do not have to be taken apart as often as before; more can be handled in less time and space and more safely for men and materials.

The truck body is of basic, lift-fork, battery-powered Elwell-Parker design. In place of a fork, however, there is a structural member resembling an elongated wishbone attached to the elevating and tilting mechanism in the truck's upright columns. The head of this member is bent forward to form a short horizontal boom. This has a hook from which is suspended a steel cross-beam. Near each end of the beam is a long flexible steel cable sling with padded stirrups for supporting the glass as it is lifted and carried. Across the main frame of the attachment and extending horizontally the width of the pack is an adjustable steel apron with rubber facing to form a backrest for the load.

PROTECTIVE HEAT MASK

Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh 8, Pa., is manufacturing a new heat mask providing better protection, comfort and free vision for workers around blast furnaces, heating furnaces, cupolas and other intensive heat areas.

The new heat mask is made of 30-mesh steel screen which deflects heat away from the wearer and prevents infrared burns. For added protection, an optional bib and/or snood made of 100% virgin wool is available. The mask weighs only 18 ounces and fits with a fiber chin rest and adjustable headgear.

BULB LACQUER

Metric Lacquer Manufacturing Co., Inc., 62 Woolsey Street, Irvington, N. J., has developed a lacquer for spraying C7½ light bulbs. Lacquer "0", as it is called, is available in white, red, orange, yellow, green and blue flat, semi-gloss and high gloss.

Among the advantages cited for the new lacquer are ease of application, adaptability to automatic conveyorized systems and complete shielding of the filament. Test data have shown that it adheres tenaciously to the glass surface, resists chipping, peeling and burning and maintains film integrity for the lifetime of the bulbs which, according to lighting engineers, averages 1000 hours at 135°C. for light colors and 150°C. for dark colors.

NESCO PLATE CLAMP

National Equipment & Supply Co., Inc., 295 Orange Street, Newark 4, N. J., has designed as standard equipment for plants handling or processing plate glass, plate mirror, plastic sheets, stainless steel sheets or any smooth surface materials, the Nesco plate clamp.

The jaws of the clamp are rubber to give a non-slip grip and to prevent marring or scratching material. Clamp sizes are available for handling plates up to 2½" in thickness and loads up to 2000 pounds.

TIME-IN-PROCESS RECORDER DEVELOPED

The Bristol Company, Waterbury, Conn., has developed a new instrument for recording time-in-process which gives a reading on a uniform scale and chart of rate of conveyor movement, directly in terms of the total time consumed by work in traveling through a process.

The readings of time-in-process are given directly with no calculations required. The recorders are used on such equipment as continuous glass lehrs, continuous ceramic kilns, continuous drying and baking ovens and continuous furnaces for metal annealing, tempering and hardening.

FLEXMOUNT PYROMETER

The Pyramid Instrument Company, 117 Lafayette Street, New York 13, N. Y., has announced the development of the Flexmount Pyrometer featuring a swivel-mount affording complete flexibility. With the simple adjustment of one set screw, the meter case can be moved in a horizontal arc from 0 to 180 degrees, providing accurate reading in all directions.

Flex arms of all sizes and shapes are available to facilitate mounting in ordinarily inaccessible locations. The pyrometer can also be furnished in flush or surface mounting without the flexmount. It has a mirrored scale 3¾ inches long, with large bold numerals, easily read at a distance.

LOW PRESSURE SHUT-OFF VALVE

Security Valve Company, 410 San Fernando Road, Los Angeles, California, has announced new improved models of the Warden Automatic low pressure shut-off valve incorporating a precision lapped synthetic rubber seat which provides for positive closure. The valve is recommended for use on gas or fluid lines where closure is desired when pressure fails from any cause.

CATALOGUES RECEIVED

Hardinge Company, Inc., 240 Arch Street, York, Pa., has issued a four-page circular describing Hardinge grinding and pulverizing mills and their application in the mining, ceramics, chemical, stone products, metallurgical and iron and steel industries.

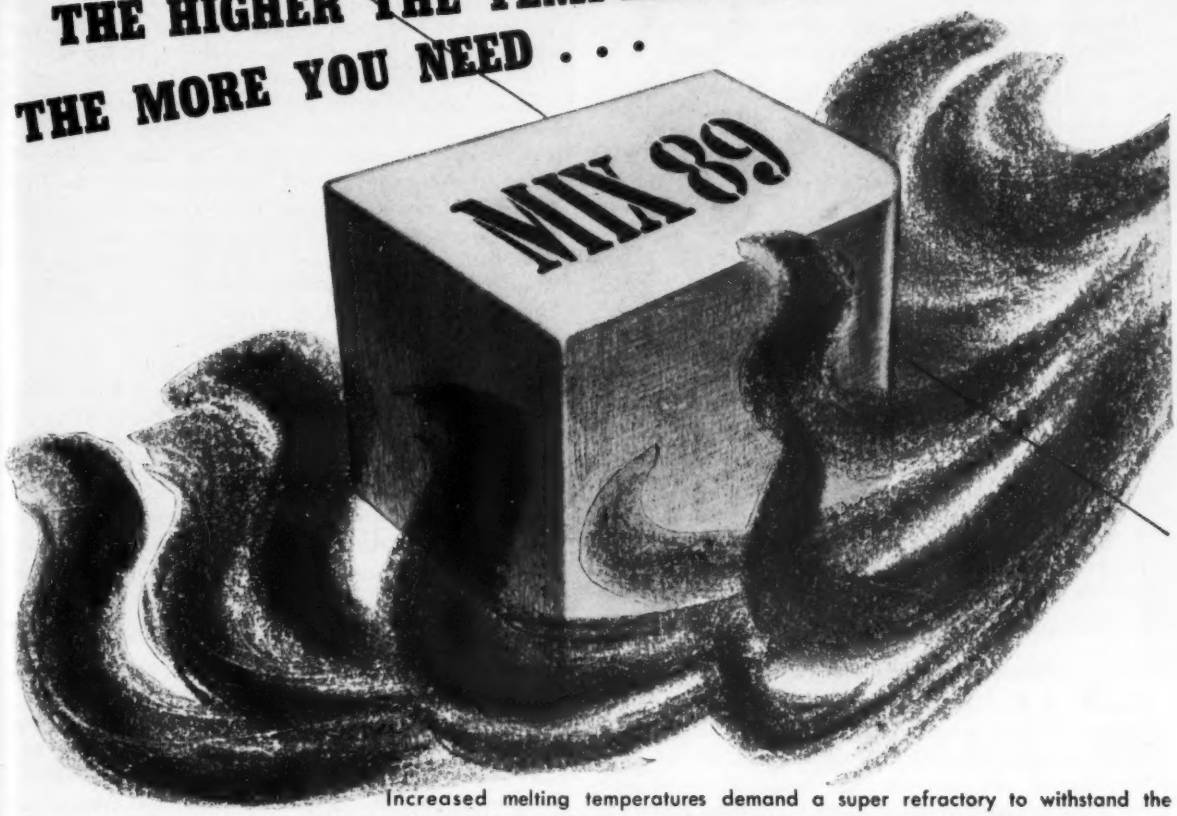
Conical mills, cylindrical mills, rod mills, tube mills and batch mills are briefly described and illustrated.

The Bristol Company, Waterbury 91, Conn., has released a new thermocouple and pyrometer accessories bulletin, No. P1238, containing 56 pages of detailed information on thermocouples, protection tubes and other pyrometer accessories.

A technical section, described as the "Users' Manual", contains engineering handbook data on such subjects as factors affecting thermocouple life, corrosion and poisoning, thermocouple reproducibility, thermocouple insulation and the things every user of pyrometers should know about selecting the right thermocouple and protection tube for every application.

A number of typical applications are illustrated. The catalogue section, described as the "Buyers' Guide", is conveniently indexed and illustrated with line drawings and photographs.

THE HIGHER THE TEMPERATURE THE MORE YOU NEED . . .



Increased melting temperatures demand a super refractory to withstand the withering flames that sweep furnace Upperstructures. MIX 89 is the answer. Expertly blended of India Kyanite and the finest Missouri clays, it defies the ravages of the serverest service:

- **Resists heat shock . . . alkaline vapors . . . destructive temperature variations.**
- **Excellent load bearing characteristics at extreme temperatures.**
- **Very High Pyrometric Cone Equivalent.**

Maximum durability means long-run economy when you use MIX 89 for all Upperstructure flame-swept locations . . . including Port Aprons, Tuckstones, Dog House Mantels, Port Sides and many similar special applications.

For those locations where today's very high rates of pull indicate that a refractory superior even to Mix 89 is required we offer Mix 257. In this product the shrinkage is even lower than Mix 89 and the Softening Point is higher. Its use is indicated only in those spots in the upperstructure where the greatest severity of attack occurs.

FOR MAXIMUM ECONOMY AND PRODUCT QUALITY SPECIFY LACLEDE-CHRISTY

One dependable source for EVERY refractory you need

LACLEDE-CHRISTY COMPANY

AMBASSADOR BUILDING **ST. LOUIS 1, MISSOURI**

Quality First

THE WORLD'S LARGEST PRODUCERS OF GLASS HOUSE REFRACTORIES

E. B. DENNIS NAMED KIMBLE'S GENERAL SALES MANAGER

The appointment of E. B. Dennis, Jr., as General Sales Manager of Kimble Glass Division of Owens-Illinois Glass Company has been announced by Stanley J. McGiveran, General Manager.

K. G. Hewitt, former Manager of the Division's Philadelphia branch, will succeed Mr. Dennis as Sales Manager of the Container and Accessories Division.

Joining Kimble Glass as a salesman in the New York office in 1933, Mr. Dennis became New York Sales Manager in 1940. He was named Container Division Sales Manager in 1941 and continued to serve in that capacity after the Kimble Glass Company became a division of Owens-Illinois Glass Company in 1947.

Mr. Hewitt joined Kimble Glass Company, Vineland, N. J., in 1923 in the Accounting Department and in 1928 became a member of the sales force in charge of the Philadelphia territory. He established the present Kimble Glass branch in Philadelphia in 1935.

LACLEDE-CHRISTY APPOINTMENT

Norman C. Michels has been appointed Manager of Operations of Laclede-Christy Company and its subsidiaries, according to a recent announcement. In this capacity, Mr. Michels will have complete charge of all manufacturing and mining operations and will report directly to Donald N. Watkins, President and General Manager.

Prior to this appointment, Mr. Michels was Chief Engineer for the company. He came to Laclede-Christy from the engineering staff of Carnegie-Illinois Steel Company. He is a graduate of Purdue University and did graduate work at M.I.T.

BALL BROTHERS LEASE CHATTANOOGA GLASS COMPANY PLANT

The leasing of the Chattanooga Glass Company's plant at Jacksonville, Florida, by Ball Brothers Company has been announced. The lease on the Jacksonville properties, owned and operated originally by the Florida Glass Manufacturing Co., will run for a year with the Ball Brothers Company privileged to renew the contract from year to year at each expiration date.

Operations in Florida will mark the company's first manufacture of its general line in close proximity to southern and southeastern markets. The move into the South, according to Edmund F. Ball, President, "will shorten considerably freight hauls of Ball-made ware and will place the company in a position to better serve these important markets." Production will include the complete line of Ball Brothers glass containers.

Milton Doremus, former plant manager for Chattanooga Glass Company, will continue in the same capacity for Ball Brothers. Floyd Seybold, formerly factory superintendent at Ball Brothers' Wichita Falls, Texas, plant, has been named superintendent at Jacksonville.

GOVERNMENT TAKES STEPS TO DISMISS CASE AGAINST OPTICAL COMPANIES

Attorney General Tom C. Clark has announced that he has directed that steps be taken to dismiss the Government's antitrust suit which was pending in the District Court, New York City, against Bausch & Lomb Optical Company, American Optical Company, Panoptik Company, Inc., and seven officers of these corporations.

Attorney General Clark stated he had directed this dismissal since no further public interest would be served by a continued prosecution of the case inasmuch as the objectives sought by the complaint have already been achieved under a partial summary judgment previously entered in the case and by the provisions of the Final Judgment entered on September 17, 1948, in the case of United States vs. American Optical Company, et al.

The complaint, filed September 16, 1940, charged the defendants with combining and conspiring to fix prices on bifocal lenses, and to sell and distribute Panoptik bifocal lenses pursuant to a sub-licensing arrangement under which only certain designated wholesalers and retailers were allowed to handle such lenses and at prices fixed by the defendants. The Government sought to prevent the continuation of cross-licensing agreements between the corporate defendants by which prices on Ful-Vue and Panoptik bifocal lenses were fixed, and to eliminate the illegal sub-licensing arrangements.

The judgment entered in September 1948 in the case of United States vs. American Optical Company, et al., enjoins the American Optical Company and Bausch & Lomb Optical Company from executing or enforcing any agreement which fixes prices or imposes other restrictions on the sale and distribution of optical frames and lenses. In addition, it contains other injunctive provisions applicable to these defendants designed to prevent the imposition of restraints upon the free flow of trade in these commodities. Thus, the practices and agreements complained of in the dismissed case are prevented by the judgments already entered.

PETITION FOR 90 CENTS AN HOUR MINIMUM IN THE PRESSED AND BLOWN GLASSWARE INDUSTRY

The Wage and Hour Division of the Department of Labor has announced an industry hearing to be held at the Department of Labor in Washington on February 9, 1949 on a petition filed by the American Flint Glass Workers' Union of North America asking for a rate of at least 90 cents an hour minimum wage on all government contracts for more than $10,000 let under the Walsh-Healey Act.

In 1938 a wage determination for this industry set a minimum of 42½ cents per hour. The proposed rate of 90 cents per hour is more than 110 per cent increase of the now prevailing rate. The testimony will permit industry views on the employment of learners at a subminimum rate and the conditions of employments of learners if any.

The manufacturers of the following ware would be affected: tumblers; table, stem and ornamental ware; oven, cooking and kitchen ware; glass fibre; foamglass; chemical glassware; industrial glass; and illuminating ware.

There's a lot O' thinkin' in GLASS COLORS by PEMCO

Sure we have our problems—the same as you or anybody in business—but our business is solving and servicing *your* problems and producing the best Glass Colors available. And when we come up with the answer it is never the thinkin' of one man. There's a heap o' thinkin' in glass colors by Pemco. No single mind could develop the improvements for which the Glass Color Division at Pemco is responsible . . . improvements in stability . . . in resistance . . . in performance. These factors emphasize why this meeting of many minds is so important to *you.*

When color is under consideration in your production we believe you will find it profitable to call in a Pemco Engineer or write us direct for data. We'll develop or match colors for specific requirements, and generous samples will be sent without cost.

PEMCO CORPORATION

Baltimore 24, Maryland

GLASS COLOR DIVISION

FUSED CAST ALUMINA REFRACTORIES . . .
(*Continued from page* 94)

explanatory. As to the third point it can be seen that the glassy matrix, leached out of a refractory material, being of different density and viscosity than the glass being melted will cause cords. As this interstitial glass is drawn from the refractories, the loosely held crystalline phase may also enter the melt causing refractory stones.

It should be noted here that should crystals of type MH, or of types K or H for that matter, enter the glass bath for any reason, their higher specific gravity should cause them to sink to the tank bottom. However, alumina-silica refractories might form mullite or other alumina-silica stones which, being less dense than corundum crystals, may be swept along by the glass into the forming machines.

The fourth point, dealing with blistering, is explained by the fact that gas pocket formations are greatly minimized during the casting operation, both because of the method of manufacture utilized and the slight porosity of these blocks due to a virtual absence of glassy matrix. Quite obviously, bubbles introduced into the glass in the refining zone or forehearth sections of a glass tank could not be fined out before this glass is processed into the finished product, and would thereby result in increased rejects.

Electric Melting

Since the refining zone has just been discussed, a refining end work, and which has excellent potentials for the overall melting practice, is electric melting.

The critical shortages of fuel, plus the promised availability of cheaper electric power, are influencing the expansion of this field. It shows some immediate potentialities in refining end work because of the possibilities of eliminating rejects as caused by crown drip in the extension channels or by exposure to waste products of combustion in the refining end. The need for a more carefully regulated drawing temperature for the molten glass itself may be answered by electric melting.

Type MH is recommended for all electric melting work in the tank proper. Although the proven purity and erosion resistance of this product are important characteristics, there are two other major factors which prompt the recommendation of type MH in this application. These are: 1) The high electrical resistivity of the crystalline phase. 2) The very small amount of glassy matrix in the refractory.

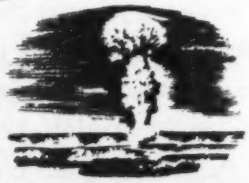
In an installation of this type, the electric current will seek the course of lowest resistance, which is in the glass bath itself and not in the refractory walls because of the extremely high percentage of alumina in MH. The high electrical resistivity of alumina is being extensively utilized by whiteware manufacturers in modern dielectric ceramic production.

Since glass conducts electricity through the medium of free sodium and potassium ions, the glassy matrix of a refractory can likewise act as a conductor, thereby contributing to premature refractory failure. Type MH, which has slightly more than 1% interstitial glass, has considerable acceptance in this field, since its low percentage of interstitial glass is distinctly unique.

*1907 was a great year...

and 1946 was one of judgment and precedent

Twenty-two top Nazis, charged with war crimes, were tried and found guilty by a 4-power International Military Tribunal at Nuremburg, Germany.



The fourth and fifth atomic bombs ever to be exploded were detonated as tests in Bikini Atoll in the Pacific on 73 old ships. (Two bombs were used on Japan during the war.)

In 1946, Banner Lime, an essential material in construction, industry and agriculture, was doing its best to supply an ever-growing market. Since the war many new applications for Banner Lime are developing, which add to an already overwhelming demand. Today, Banner Lime is expediting production in every way possible to satisfy this growing range of usefulness.

Wherever you go... Whatever you see...

BANNER LIME *is in the picture*

Banner Lime is a basic material of modern civilization. It is required in . . .

BUILDING—finishing coat and base coat plaster, mortar, concrete, germicidal washes and paints.

AGRICULTURE—soil conditioner, plant food, fertilizer ingredient, plant protecting and leaf-feeding dusts and sprays.

INDUSTRY—in the making of glass; in the steel industry; innumerable chemical processes; water treatment.

Essentially yours

Banner Lime

FAMOUS OHIO DOLOMITE

NATIONAL MORTAR & SUPPLY COMPANY

GRANT BUILDING, PITTSBURGH, PA. • ESTABLISHED 1907*

GLASS . . .

Stronger, More Lustrous, More Resistant to Chemical Attack

BECAUSE OF ADDED ALCOA ALUMINA

These crystal-clear Neutraglas* ampules made by Kimble Glass are so outstanding that Kimble can claim for them "the highest resistance to chemical attack of any known 'workable' glass."

Kimble uses ALCOA Alumina in making Neutraglas for the same reason that manufacturers throughout industry use ALCOA Aluminas and Fluorides. They help make products the *best* of their kind. Spark plugs . . . abrasive wheels . . . refractories . . . rubber . . . tooth paste . . . lumber—are but a few of the hundreds of products which are measurably better because of ALCOA Chemicals.

We've done a lot of research on the advantages of ALCOA Aluminas and Fluorides in many different products and applications. It is probable that we have data already on hand to help solve a problem of yours. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 1467 Gulf Building, Pittsburgh 19, Pennsylvania.

*Trade name of Kimble Glass, Division of Owens-Illinois Glass Co.

ALCOA

ALCOA CHEMICALS

ALUMINAS AND FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • LOW SODA ALUMINAS • TABULAR ALUMINAS • HYDRATED ALUMINA
ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE

P. W. HATCH NAMED ASSISTANT GENERAL SALES MANAGER AT BALL BROTHERS

The appointment of Philip W. Hatch as Assistant General Sales Manager of Ball Brothers Company has been announced. Mr. Hatch has been connected with the company for 17 years.

In his new capacity, Mr. Hatch will assist in the planning and direction of sales programs and promotions of Ball glass packerware containers and the company's line of commercial closures. For the last ten months preceding his new appointment, Mr. Hatch had been directing all sales of commercial zinc and rubber products other than those of the Domestic Products Division. He will continue to direct those sales, and will also continue to serve as General Manager for the Ball subsidiary, American Zinc Products Division.

Mr. Hatch joined the firm in 1932 and has been with the company continuously with the exception of five years when he served in World War II. He served as credit manager with Ball Brothers, and filled several positions in the company's zinc and rubber divisions.

● Branson Instruments, Inc., has announced the moving of their quarters in Danbury, Conn., to larger offices at 436 Fairfield Avenue, Stamford, Conn.

ROBERT GALBRAITH OF DU PONT DIES AFTER ILLNESS

Robert Galbraith, ceramics sales representative in the Cleveland, Ohio, office of Du Pont's Electrochemicals Department, died following illness.

Mr. Galbraith, after serving in World War I, entered the University of Illinois in 1919 and was graduated in 1923 with a bachelor of science degree. He was later employed by the American Terra Cotta Company and the Harshaw Chemical Company as a ceramic engineer and salesman.

In 1933, he joined the Du Pont company as a salesman in the Cleveland district of the Electrochemicals Department. Five months later, he was made district sales manger of ceramic products and, in 1940, his responsibilities were broadened to include sales and service of ceramic products. He held this position for several years, starting in Cleveland and later at Perth Amboy and Wilmington. He returned to Cleveland in 1947.

NEWLY-CREATED POSITION AT CORNING

Corning Glass Works has announced the appointment of T. Parks Brownrigg to the newly-created post of assistant manager of direct sales for the company's Consumer Products Division.

In his new position, Mr. Brownrigg will assist in the merchandising of such Corning products as beverage ware, tableware, Christmas tree ornaments and lamp chimneys. He will also handle the department's premium sales.

MELTING and FINING

BORAX...a small addition of B_2O_3 to the glass batch, if properly substituted for a part of one or more of the major constituents, will improve the melting temperature and fining rate which should effect economies in fuel and refractory life.

• • •

Our representatives are prepared to discuss all the special advantages of B_2O_3 in glass.

PACIFIC COAST BORAX COMPANY

NEW YORK
CHICAGO
LOS ANGELES

One of a series *of messages to help you increase your understanding of business paper advertising, and its effect on your job.*

How much would NO advertising cost your company ?

SOME COMPANIES look upon advertising as an expense. When expenses have to be cut, the advertising budget looks like a good place to begin.

The only trouble with that theory is — it won't work.

Advertising can become expensive when you don't use *enough* of it. And "NO advertising" can cost far more than the "saving" it appears to create.

It's like failing to lubricate a piece of valuable machinery. You save the cost of the lubricant — but eventually there's a big repair bill to pay, not to mention your production losses while the machine is idle.

Advertising works something like a machine. It is the application of assembly-line methods to the five basic steps in the manufacture of a sale —

1. **Seeking out prospects**
2. **Arousing their interest**
3. **Creating a preference for your product**
4. **Making a specific proposal**
5. **Closing the order**

Can advertising perform all five of these steps? No, it usually takes a good salesman to handle the last two. But advertising *can* save much of his valuable time.

By mechanizing the *missionary job*, advertising becomes the most efficient method of manufacturing sales at a profit. Especially when it appears in the business press, where it is concentrated among your company's best prospects — *and no one else!*

THE GLASS INDUSTRY

is a member of The Associated Business Papers, who have published an interesting folder entitled, "10 ways to measure advertising effectiveness." We'll be glad to send you a copy. And if you'd like reprints of this advertisement (or the entire series) to pass along to others in your organization, just say the word.

GLASS AND THE FUTURE . . .

(*Continued from page* 81)

which indicate present and future trends in the glass industry. More glass plants are being located in the far West and the Southwest in order to take advantage of the recent shifts in population as well as the availability of raw materials and low-cost natural gas as a fuel. Although industrialization of the West Coast has set in, it is not nearly complete and considerable room for industrialization still exists*. The chemical, steel, nonferrous metals, rubber and petroleum industries have experienced growths, and the largest population gains** during the war occurred on the Pacific Coast. The increase in population from 1939 was over 20 per cent. Only one other state, Florida, had a corresponding increase. The output of glass containers in the West*** is at a high level as a result of the growth of the beverage and food processing industries of this region. Approximately five large new plants have been built in the postwar period.

Uses

The forward progress of the glass industry has tended toward the use of glass along functional lines. The increased container production, established during the war has maintained itself to a definite extent, and the importance of flat glass in the over-all picture of the glass industry is obvious. The increased use of plate glass in modern living, such as in the improved automobiles of today and in the residential buildings, has had a pronounced effect on this progress. These increased uses are largely a result of trends in thinking by designers and architects, and the industry itself should follow these trends so as to establish this market on a broad basis for the future. This trend utilizes one of the functional qualities of glass which cannot be duplicated by any other material at a reasonable cost. Development programs, such as the work being done on the fundamentals involved in the use of glass in solar housing, may contribute markedly to the advance and increased use of this material. The development and utilization of glass fibers, photosensitive glass, tempered glass, laminated glass, outlets in television, sealed-beam head lights, etc., have all been made possible by a large amount of fundamental and engineering development work. Functional design has been adopted by the glass makers and has resulted in establishing the position of glass for specific uses. For example, one-way beer bottles, square milk bottles, etc., all tend to permit greater utilization of glass. The container industry during the war gained a marked advantage owing to the shortage of other container materials, and by the proper development work it should maintain this advantage. With the possible exception of the beverage industry, the gains in the container industry will be short-lived unless serious attempts are made to maintain glass in its proper perspective. Proper packaging of the container is an important factor in maintaining the position of glass in the container industry.

The majority of the patents and other published

* Chemical and Engineering News, Vol. 25, No. 38, September 22, 1947.
** Business Week, December 20, 1947.
*** Chemical Engineering, September, 1947, p. 115.

GLASS MACHINERY COMPANY

FAIRFIELD, CONNECTICUT, U.S.A.

• THE ONLY CHEAP LABOR IS GOOD AUTOMATIC MACHINERY •

literature during the past year have been concerned primarily with the development of optical glass compositions having specific properties, the development of coatings for glass and the production of glasses having specific transmission characteristics. A fair number of contributions were made during the past year, especially with regard to utilizing various tools such as the electron microscope in obtaining a better understanding of glass.

GLASS IN THE INDIAN TERRITORY . . .
(*Continued from page* 91)

red hot balls of molten glass. It would be very interesting to watch his reaction to the present modern methods of producing the same articles, not to mention the incredible sight of his children, and many other children of his race, efficiently producing all kinds of glass products by merely pushing electric buttons. Throughout the industry, hundreds of full blood Indians are working side by side with others of mixed bloods and those of European birth or parentage.

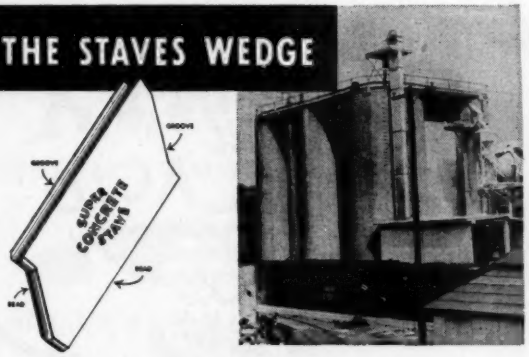
Records of one major company show the full blood Indian to be among the most loyal employees. Contact with the white man has not as yet corrupted their centuries old trust in their fellowman. Many speak broken English, but their understanding is perfect. When we consider that his civilized background dates back a mere generation or two, his I.Q. surpasses that of many whites who boast of civilized ancestors dating back thousands of years.

It would indeed be interesting to conduct the Old Chief through Oklahoma's fourteen glass plants: Hazel-Atlas Glass Company at Ada and Blackwell; Pittsburgh Plate Glass Company at Henryetta; Brockway Glass Company and Corning Glass Works at Muskogee; Ball Brothers Company, American Window Glass Company, Ruppert Glass Company, Shaw Convex Glass Company and Southwestern Sheet Glass Company at Okmulgee; Kerr Glass Mfg. Company at Sand Springs; Bartlett-Collins Company and Liberty Glass Company at Sapulpa; and Overmyer-Perrem Glass Company at Tulsa. He would probably shake his head to clear it of the speed and hubbub just experienced before offering any comment, but it certainly is safe to assume that this stalwart son of nature would hesitate before repeating his previous opinion of the first glassworkers he had seen years ago when they had reminded him of a group of condemned men working in hell and beating a weary trail home after a hard day's work.

The tall chimneys reaching to the sky, the furnaces with more fire than all the Indian camp fires put together and the large building, he would see today as in 1902. But the men of today did not seem to sweat as much as those he had seen in that Kansas factory. And another thing that would certainly strike him as being different—no one seems to walk home all tired out nowadays. Everyone seems to have a car parked around the plant somewhere.

No, it isn't using too much imagination to believe that the Old Chief would change his remark to, "I'd rather be a glassworker than an uncivilized Indian."

THE STAVES WEDGE



As you will see in the illustration of a Neff & Fry Super-Concrete Stave, the ends are mitered and the edges are grooved and beaded. Because of this patented design, each stave interlocks with six contiguous ones, forming a firm and symmetrical structure.

The ends of the staves are further supported by heavy galvanized steel rings drawn tight around the zigzag joints. Between these rings, as many others are placed as needed to resist the calculated lateral pressure.

Neff & Fry Bins are used for handling and storing aggregates, ashes, cement, chemicals, cinders, clay, coal, coke, fertilizer, grain, gravel, lime, limestone, minerals, ore, sand, sawdust, scrap, seeds, slag, water, wood pulp, and many other materials.

We'll be glad to give you the benefit of our 28 years' experience in engineering and erecting storage bins. Write, wire, or phone.

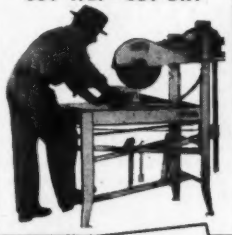
NEFF & FRY STORAGE BINS
FOR ALL SORTS OF BULK FLOWABLE MATERIALS

THE NEFF & FRY CO., Camden, Ohio

New Slant on MASONRY CUTTING

MAKE Any CUT IN SECONDS
WITH NEW 1949
Clipper
MASONRY SAWS

CUT WET—CUT DRY



You can slice through the hardest masonry materials quickly, easily, and economically with new portable Clipper Masonry Saws. There's a secret behind this smooth, fast cutting Clipper action—it's the automatic Pressure Equalizer Spring. Clippers are built to withstand the roughest treatment on any job yet will consistently make straight and intricate cuts in seconds. Clipper, the only masonry saw with the Pressure Equalizer Spring, combines the Multiple Cutting Action with the new "Adjust-A-Cut" control to make possible the fastest cuts at the lowest cost.

DUSTLESS CUTTING WITH CLIPPER
The 100% answer to masonry cutting is achieved with the 1949 Model HD Clipper. This Dustless Model cuts wet and cuts dry—actually making it two saws in one.

FREE TRIAL
9 models available for immediate shipment. Be sure—yes, test and try Clipper on your job before you buy—you won't be obligated in any way. Priced from $195.00... Shipped direct from Clipper Factory Branches located Coast to Coast.
Write now for illustrative literature.

NATION-WIDE DIRECT FACTORY SERVICE
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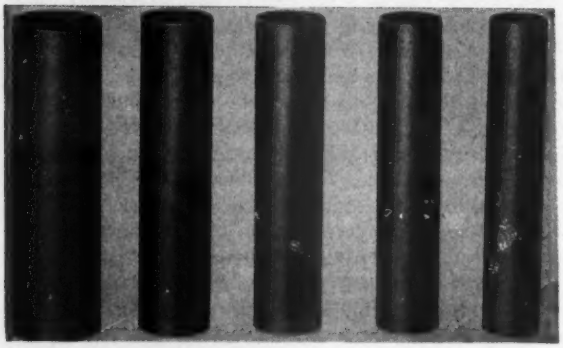
GUNITE



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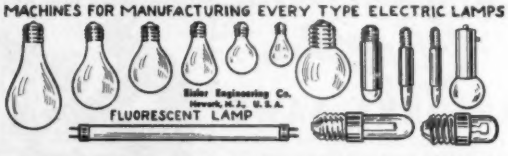
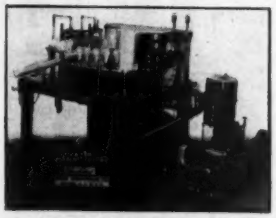


BULB BLOWING MACHINES — AMPULE MACHINES



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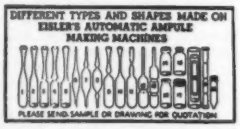
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DIAMOND ALKALI ELECTS EXECUTIVE VICE PRESIDENT

The election of John A. Sargent as Executive Vice President of Diamond Alkali Company has been announced by Raymond F. Evans, President, following a meeting of the Board of Directors. Mr. Sargent was formerly Vice President of Finance, which post he has held since early 1947.

A graduate of Sheffield Scientific School of Yale University, Mr. Sargent was at one time Vice President and General Sales Manager of the Campbell Metal Window Corporation. When this company merged with the Truscon Steel Company, he became Sales Manager of the Truscon organization. He joined Diamond Alkali Company as its Treasurer in 1946.

OWENS-CORNING NAMES COMPTROLLER

The appointment of Hal M. Cranston as Comptroller of Owens-Corning Fiberglas Corporation has been announced.

Mr. Cranston joined the Fiberglas Corporation at the time it was founded in 1938 as general supervisor of accounting. In 1943, he was appointed assistant treasurer and auditor.

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CLASSIFIED ADVERTISEMENTS

HELP WANTED

Large Midwestern glass company requires capable analytical chemist for work on silicate analysis in the research department. No routine work. Give complete details of experience and salary required. Address Box 85, c/o The Glass Industry, 55 West 42nd Street, New York 18, N. Y.

YOUNG GLASS TECHNOLOGIST graduate desired by large Mid-Western company. Plant or research experience in plate glass industry would be helpful but not necessary. Reply giving full particulars and date available to Box 86, c/o The Glass Industry, 55 West 42nd Street, New York 18, N. Y.

BATTELLE MAKES APPOINTMENT TO BOARD OF TRUSTEES

Dr. Frank B. Jewett, formerly Chairman of the Board of Bell Telephone Laboratories and formerly President of the National Academy of Sciences, has accepted an appointment as a member of the Board of Trustees of Battelle Memorial Institute. Dr. Jewett will fill a vacancy created by the death of Dr. Rolland C. Allen.

The new Battelle trustee is one of the outstanding research leaders of the era. A physicist and electrical engineer by training, he was associated with the American Telephone and Telegraph Company and the Western Electric Company in engineering posts during the period of the greatest technological developments in communications.

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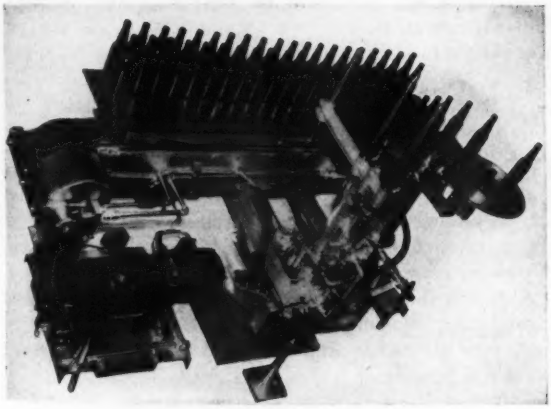

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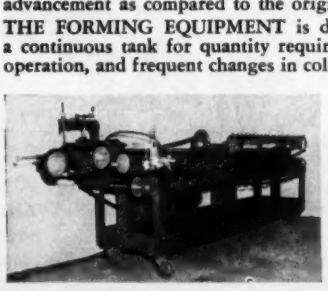

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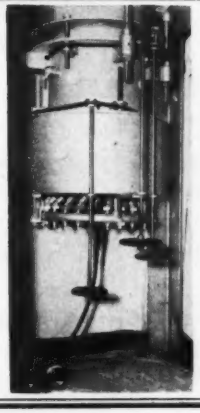

LYNCH CORPORATION PERSONNEL CHANGES

The Lynch Corporation has announced that Tom C. Werbe, Jr., has been named Director of Manufacturing replacing J. L. Watts, retired.

At the same time, Richard H. Werbe has been appointed Manager, Service Parts Department, and Wendell D. Jones, formerly connected with the Slick Glass Company, is now associated with Lynch's Sales Department.

Robert Wiley, formerly of the company's Marion, Indiana, operation, has been transferred to Anderson as an assistant to C. E. Cooper, Chief Engineer.

PITTSBURGH CORNING TRANSFERS HOME OFFICES

The home offices of the Pittsburgh Corning Corporation are being moved from the Pittsburgh Plate Glass Company Building to 307 Fourth Avenue, Pittsburgh. The larger quarters will enable the firm to better serve buyers for its products.

Although the address is to be changed, the corporate organization remains the same. Pittsburgh Corning now owns four plants for producing its products and employs about 700 persons.

• Wallace F. Bennett has been named President of the National Association of Manufacturers to succeed Morris Sayre, who became Chairman of the Board of Directors. Mr. Bennett is a former President of the National Glass Distributors Association.

FOREIGN PENNSALT SUBSIDIARY ORGANIZED

The formation of Pennsalt International Corporation, a subsidiary, has been announced by the Pennsylvania Salt Manufacturing Company, to take over the varied foreign interests of the parent company. Richard L. Davies has been appointed President of the new firm and John H. S. Barr has been named Vice President.

The new company will import and export chemicals and raw materials. In addition, it will perform a service in the exchange of technical information relating to chemical processes. It will handle imports for the parent company.

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